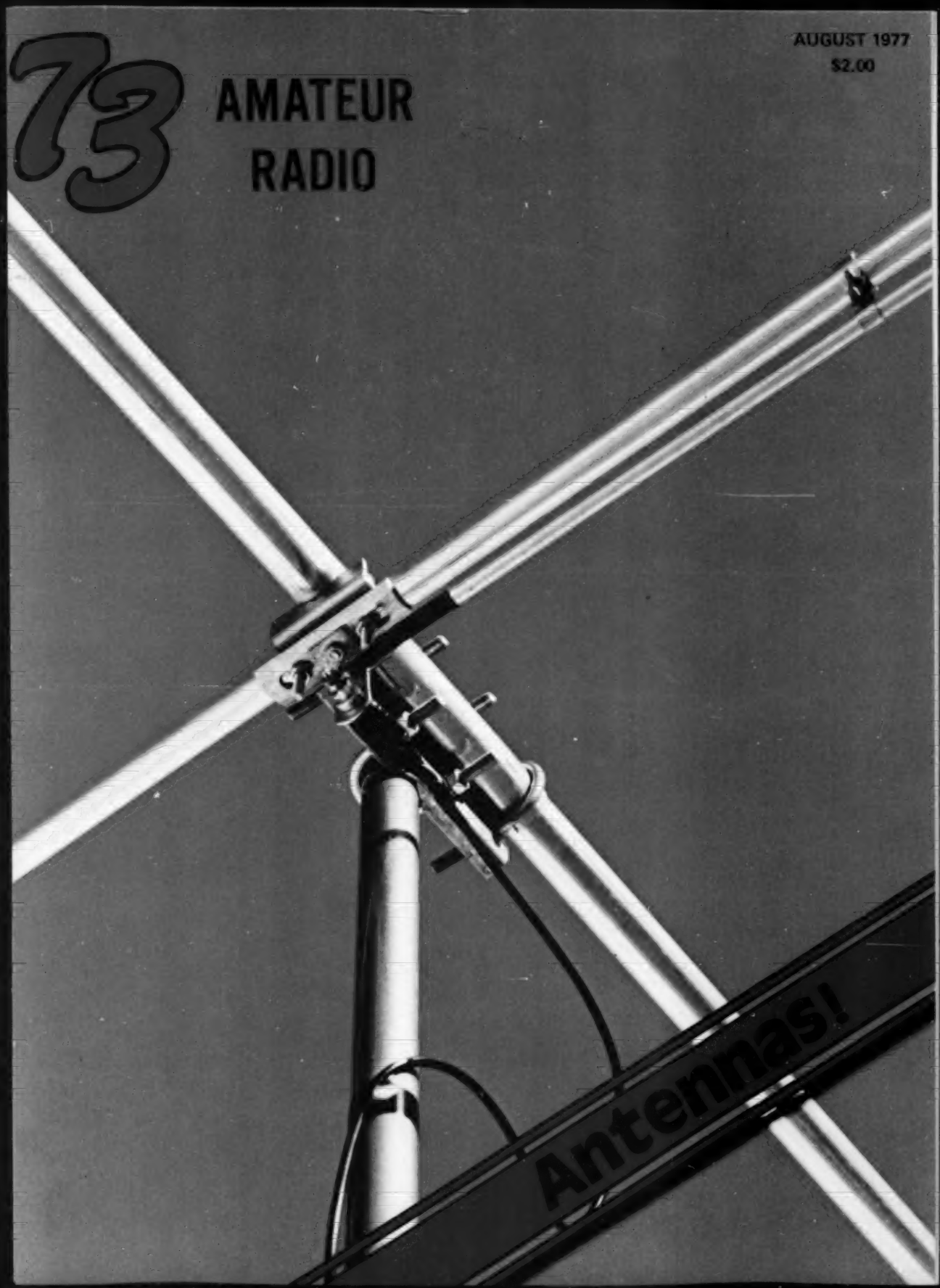
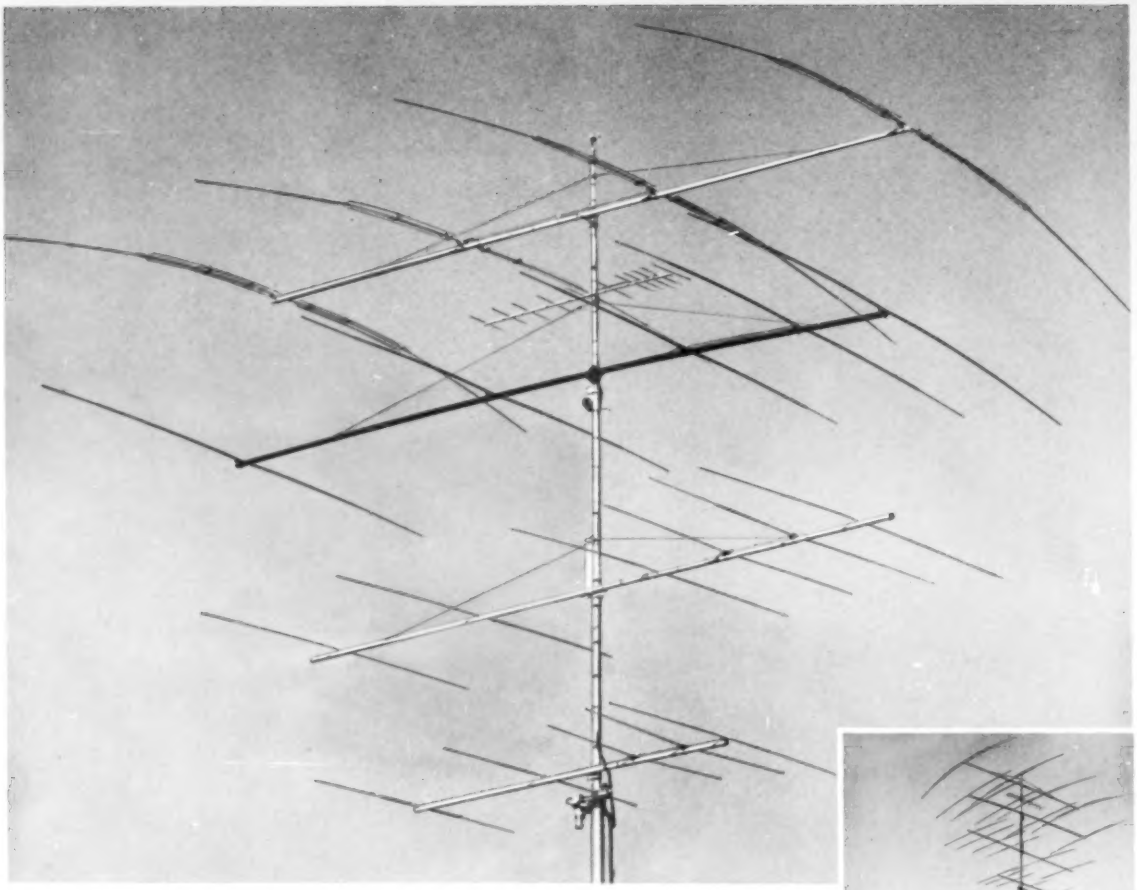
73 AMATEUR RADIO

AUGUST 1977
$2.00



Antennas!



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SPECIFICATIONS

FREQUENCY COVERAGE	*144.00 to 148.00MHz	SPURIOUS RADIATION		SQUELCH THRESHOLD	-5 dB OR LESS (FM)
MODES	FM (F3)	MAXIMUM FREQUENCY DEVIATION	±5KHz	SPURIOUS RESPONSE	-60 dB OR BETTER
	*SSB (A3A), CW (A1)	MICROPHONE IMPEDANCE	600 OHMS	SYNTHESIZER	
SUPPLY VOLTAGE	DC 13.8V ±15%			FREQUENCY RANGE	144.00MHz to 148.00MHz
SIZE (mm)	60(H) x 150(W) x 230(D)	RECEIVER SENSITIVITY	*ADJ. AT 0.5 MICROVOLT INPUT GIVES 10 dB S+N/N FOR 0.1 MICROVOLT OR LESS FOR 20 dB QUIETING S+N/N AT 1 MICROVOLT INPUT 20 dB	STEP SIZE	5 KHz for FM *100 Hz or 5 KHz for SSB
WEIGHT	2.7				PER C IN THE RANGE OF -10 TO +60C, ±0.0001×OPR.
TRANSMITTER				STABILITY	
TX OUTPUT	FM 10W *ADJ. 10W (PEP), A1 10W				
CARRIER SUPPRESSION	40 dB OR BETTER				

*VALID WITH SSB UNIT ONLY

VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT

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Moak

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COVER: Photo by Stan Miastkowski WA1UMV.

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73 STAFF

EDITOR/PUBLISHER
Wayne Green W2NSD/1

EXECUTIVE VICE PRESIDENT
Sherry Smythe

EXECUTIVE EDITOR
John Nicole WA3ETD

MANAGING EDITOR
John C. Burnett

ASSISTANT MANAGING EDITOR
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Beth Turin

I/O EDITOR
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PUBLICATIONS EDITOR
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Gayle Cebeas
Bob Drew
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Weston Parker
Bob Sawyer
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Dwight Perry

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EDITORIAL BY WAYNE GREEN

ARE YOU MISSING SOME GOOD ARTICLES IN KILOBAUD? YES!

Our policy is to make sure that articles are not reprinted between *73* and *Kilobaud* . . . and this means that you are missing a lot of very important material if you are not getting *both* magazines.

The articles in *Kilobaud* cover a wide range of topics, centered on the new microprocessor chips . . . articles on wire-wrapping, how memory works, the new printers, handling ICs, surplus keyboards, video terminals, video generators, and a lot of stuff on the various microcomputers and programs for them . . . a whole lot.

Most of this material will be published just once, so you'll need your back issues of *Kilobaud* to use as a library for reference . . . on business programs, games, operating systems, interconnections of popular boards, etc.

You'd best send in your subscription now . . . before this new scene gets too far away from you. It's going to be big . . . and fun . . . and there is more opportunity here than in anything we've seen in the past.

Send in your subscription to *Kilobaud* and find out why it is the most popular small computer magazine out. It's just as packed with good articles as *73* . . . and you already have the background to understand them.

OPENINGS AT 73

The staff at *73* is at an all-time high . . . and still more are needed to pursue the expanding magazine, book, and computer aspects of the business. Help is needed in the form of a dyed-in-the-wool amateur with writing and editing experience, to help with the rapidly growing book department. Help is needed in drafting. We need someone to work at *73* and draft the schematics for the magazine. Computer programmers and technicians are needed to help with the development and production of business and educational programs for microcomputers.

Oddly enough, *Kilobaud Magazine* may surpass *73* in revenues within its first year of publication, and the sale of computer programs is expected to soon dwarf both magazines in sales.

Our first big exposition, COMPUTERMANIA ™, will be held in Boston in late August, and is the first of many such expositions we'll be running. This show is budgeted at $350,000, so it is a big undertaking. Further shows are being planned for San Francisco and other cities, using the team which will be putting on COMPUTERMANIA. Not bad for a tiny group of people in New Hampshire who are having the time of their lives.

CODE LEARNING SYSTEMS STUDIED

A recently released study from the University of Southern Illinois showed the results of a series of code learning tests. The conclusions to be drawn from these tests were inescapable.

This was essentially a test of the *73* system of learning the code vs. the system used by most other code courses (such as those from the ARRL). The main difference is that the *73* system starts beginners out with the sound patterns of code sent at 13 words per minute, while the others start out with the individual characters sent at a very low speed and change the sound patterns as they speed up.

The result, as has been noted in *73* before, is that the *73* code tapes do not have the pronounced learning plateau to be surmounted that other tapes do. Thus the *73* tapes require substantially less time for mastering the code.

The faster learning with the *73* code tapes results in a much higher percentage of Novices being licensed, and far fewer dropouts in the Novice courses run by clubs. Clubs running Novice or Tech (or General, for that matter) programs should make note of this and use the *73* Morse code tapes.

I/O MAGAZINE

The first hobby computer magazine in Japan got started last November. The editor and publisher is a very active ham and computer fanatic by the name of Nishi. Where did the magazine's name come from? From the I/O section of *73* — which he's been reading for years.

Nishi came up to visit *73* HQ last winter — a most interesting and entertaining chap. It is a little unsettling to see what Nishi has done so far . . . and he's only 21 years old! He's been into computerized music for several years

Nishi, Sherry, and Wayne in Los Angeles.

Continued on page 16

TR-7500

There are a number of good 2 meter FM transceivers on the market. You may already own one. But, even if you do, we suggest that you put your radio to this test. And, if you're thinking of buying one, this test should be a helpful guide.

	NO	YES
Is it PLL synthesized?	☐	☐
Does it have 100 channels (88 pre-programmed)?	☐	☐
Does it have 12 extra diode programmable channels?	☐	☐
Does it have single knob channel selection?	☐	☐
Does it have a LED digital frequency display?	☐	☐
Dos it have a powered tone pad connection?	☐	☐
Does the receiver have helical resonators?	☐	☐

If your answer is NO to any of these, the TR-7500 is the radio that you should own. And, in addition to these important features, you get proven Kenwood quality, value and service.

TR-7500 Specifications

Semiconductors: Transistors.....41
FETs.....8
ICs.....7
Diodes.....35

Frequency Range: 146.01 to 147.99 MHz
Mode: FM
No. of Channels: 100
Operating Temperature: —20 to +50 degrees C
Power Voltage: 11.5 to 16.0V DC (13.8V DC nominal)
Grounding Polarity: Negative ground
Antenna Impedance: 50 Ohms
Current drain: Less than 0.5A in receive with no input signal
Less than 3A in transmit (HI) Less than 1.5A in transmit (LOW) (at 13.8V DC)
Dimensions: 172 mm (6—3/4") wide
250 mm (9—7/8") deep
75 mm (2—15/16") high
Weight: Approximately 2.2 kg (4.8 lbs.)

TRANSMIT SECTION

RF Output Power: High: 10 Watts
Low: 1 Watt
(approximately)
Modulation: Variable reactance frequency shift
Frequency Deviation: ±5 KHz
Spurious Radiation: Better than —60dB
Tone Pad Input
Impedance: 600 Ohms
Microphone: Dynamic microphone with PTT switch, 500 Ohms

RECEIVE SECTION

Receive System: Double conversion superheterodyne
Intermediate Frequency: 1st IF: 10.7 MHz
2nd IF: 455 kHz
Sensitivity: Better than 0.4 uV for 20dB quieting Better than 1 uV for 30dB S/N
Squelch Sensitivity: Better than 0.25 uV
Selectivity: 12kHz at —6dB down
40 kHz at —70dB down
Image Rejection: Better than —70dB
Spurious Interference: Better than —60dB
Audio Output: More than 1.5 watts across 8 Ohms load 10% distortion
Intermodulation: Better than 66dB

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LETTERS

CB TO 10

I was quite pleased to see the "CB to 10" articles which appeared in the May issue. The conversion of CB gear for amateur use has intrigued me for some time, and hopefully this compendium of information will spur more hams to action in this area.

I must point out one glaring error in W4NVH's article, however. Bob states that several Cobra, Midland, and Pace SSB transceivers may be converted to 10 meter SSB by merely changing the 7.8025 MHz carrier oscillator rock. While at first glance this does appear possible, and is an attractive idea since only one replacement crystal would be required, it just will not work. These particular SSB CB units are equipped with a 7.8025 MHz crystal filter (of excellent quality) which acts as a bandpass filter in the transmit and receive modes. Changing the carrier oscillator frequency by approximately 1 MHz would put it outside the usable pass band of this filter. Furthermore, the carrier oscillator affects only the USB transmit and receive functions. The transmit and receive frequencies would remain unchanged in the AM (DSB) and LSB modes.

The Cobra and Midland models mentioned in the article derive their operating frequencies as outlined below (note that the component designators referred to are for the Cobra 138A):

USB Transmit and Receive: Transmit Freq. = Local Osc. - Carrier. LO Freq. = (Carrier x 2) + Synthesizer High + Synthesizer Low. For CB Channel 1 (26.965 MHz), the LO operates at 34.7675 MHz, derived from (7.8025 x 2) + 11.0035 + 8.1590.

AM Transmit, LSB Transmit and Receive: Transmit Freq. = Local Osc. + Carrier. LO Freq. = Synthesizer High + Synthesizer Low. For CB Channel 1, the LO operates at 19.1625 MHz, derived from the combination of 11.0035 + 8.1590 MHz.

AM Receive: Local Oscillator Frequency is shifted up 2.5 kHz from the AM/LSB transmit frequency. Diode D28 is switched on, shorting out the 15 pF capacitor C74 to shift the 8 MHz oscillator frequency.

In practical terms, this means that the four 11 MHz oscillator crystals (X1 through X4) must be changed for 10 meter operation. The following set of four crystals, substituted in the Cobra 138 or 139 and Midland 13-895, will allow you to operate SSB using channel positions 1 through 16. The corresponding frequencies would be 28.600 to 28.790 MHz. Channels 17 through 23 could then be used in the AM (DSB) mode between 28.800 and 28.890 MHz, in keeping with present 10 meter practice. X1 = 12.6385 MHz; X2 = 12.6485 MHz; X3 = 12.6585 MHz; X4 = 12.6785.

If your bent is more toward SSB operation than DSB, I suggest using a 12.6685 MHz crystal in place of the X4 value above. This would yield six additional frequencies between 28.6 and 28.8 MHz.

One important operating note: The RIT control on these transceivers (known as "clarifier" or "voice lock") shifts both the transmit and receive frequencies in the SSB and DSB modes. I would advise reasonable precaution when operating, to avoid "leapfrogging" clear out of the channel frequency. The normal range of frequency shift involved is ±800 Hz.

Incidentally, the Howard Sams CB Radio series (which now runs to some 122 volumes) contains excellent schematics and alignment procedures for almost any CB set worth the trouble of converting (and, I might add, quite a number of them which aren't).

Good luck, and CU on 10!

Stan Modjesky WB3CJI
Woodlawn MD

Thanks for the tips, Stan. Hopefully your suggestions will be implemented by readers anxious to get going on 10. Several others suggested similar changes to the Cobra SSB transceiver. Special thanks to Bill McDonald W1IIU who called in the problem and supplied schematic drawings of the rig. — J.M.

THANKS

I would like to take a few lines in your magazine to thank certain members of the Amateur Radio Society in beautiful Southern California. My first round of thanks goes to Bill Pasternak WA6ITF: After calling and telling him about my plans to come to California for two weeks, he gave me names of people, repeater frequencies, and places to visit. He even opened his house to me (regretfully, time did not permit me the opportunity to visit).

Thanks should also go to SANDRA for the use of their 04/64 repeater and for having such a dedicated group of people on it. Cybil W6GIC and Lon Albright W6FLF offered to assist me in a phone patch back home (again, because of a hectic schedule I had to forego taking them up on their offer). Net control station for the San Diego ARES, Mike WA6HJJ, assisted me in getting hooked up with Jim WA6UFY for sending eastbound traffic on the NTS net. This was my first time, and Jim was very helpful. (My wife got a kick out of the amateur radio-transmitted telegram.)

David K. Gordon WB2YUJ
Holbrook NY

P.S. Keep up the good work. You have a great magazine.

REBUTTAL

At the outset I shall give anyone reading this a frame of reference by which they can "consider the source."

I am not a ham. I am a research associate in the field of neurosurgery.

I bought the *73* code course to learn the International Morse Code, and perchance in the future obtain a ham license. For what purpose I wasn't quite sure . . . then. I availed myself of the attached offer for a three month trial subscription to *73 Magazine*. This wasn't done blindly, as I was somewhat familiar with your publication through a ham friend (which also gave me the opportunity to read other mags, namely *QST*, et al).

The motivation to write was provided by the letter from David Wever WB2CQX, in the May, 1977, issue.

Mr. Wever starts by accusing *73 Magazine* of "slander." Since he seems to demand absolute accuracy, we should start by informing him that Mr. Webster defines slander as: "The utterance or spreading of a *false* statement or statements, harmful to another's character or reputation." Slander is also further distinguished from libel in that the former is spoken and the latter, written. (You've been sending him editorials on cassette tapes, maybe?)

The key word, of course, is "false." If he therefore demands "proof," in every respect, of your allegations, he should, by his own set of rules, show evidence that his accusation of "slander" (we'll allow a stretching of its definition to include the written word) is accurate by showing us where particular *false* statements have been made in your editorials. He might also do well to keep in mind that an editorial is, by definition, usually the nature and content of one man's opinion.

Mr. Wever specifically cites as an example your editorial in the Feb., 1977, issue condemning the ARRL's lack of involvement in WARC, where he accuses you of nowhere offering "any concrete evidence of what the ARRL is doing." If memory serves me, the editorial was concerned with what the ARRL was *not* doing. In an editorial, how does one prove such an allegation? By showing photographs of empty rooms where ARRL reps did not attend a given meeting? Or perhaps of pieces of blank stationery depicting correspondence that was never written?

I have many friends who are hams, several of whom are also League members, none of whom was given the opportunity of expressing a desire, pro or con, as to the disposition of the $800,000 being spent on the League's new HQ building.

I possess neither the verbosity nor the ink to reply to everything in the "Word for Word" letter, but a few more points might be in order.

Wever infers by a question that *73* selects as many anti-League letters as possible for publication. One very positive factor in my choosing *73 Magazine* for subscription from among the several options was its open willingness to publish letters criticizing various facets of its publication, as is most markedly exemplified by the "Word for Word" printing of Mr. Wever's letter.

Our friend seems also to have a propensity for expressing his criticisms in superlatives, thus again violating his own rules for evidence. Such statements as, "I don't see where *73* does anything at all save sit around and condemn the ARRL," or, "misconstruing and taking out of context everything in a League publication," are rather blanket condemnations for someone demanding absolute proof and documentation, and presenting none. Where is his evidence or proof that *anything at all* was misconstrued or taken out of context?

He condemns you with no evidence for condemning the ARRL with no evidence and closes by attempting to cut off any logical discussion of his accusations by stating, in effect, that anyone using his methods to reply is only proving his point further.

Possibly the only way to please anyone who would occupy two full columns of print with non-stop criticism would be to design only the cover of your mag and mail it to him bound with 200 blank pages, thereby permitting him to make *73 Magazine* anything he wishes. Then if the product displeases him, the problem does not lie with your publication.

You have done more than was required of you in being fair to Mr. Wever by publishing his letter "Word for Word" — now please be as fair to yourselves and those readers who are of the opinion that *73 Magazine* is an extremely high quality publication (both editorially and technologically) by publishing this letter, if not "Word for Word," then as a representatively-edited facsimile.

Thank you very much for a superbly entertaining and informative publication.

Dale E. Brown
Loma Linda CA

KUDOS

Greetings. I have noticed in your magazine comments on new equipment, but have not found too much regarding the problems the manufacturers are having with their solid state transceivers (which seem to be more in units that are American-made than in out-of-country machines).

Recently, I scquired a Brimstone 144 from the TEC-KAN people in Salina, Kansas, which gave up soon after it hit the air, having locked up the transmit section.

On sending it back to the factory, I received a long distance call from Mr. Dennis Hatch of the company, who told me they were shipping a new unit to me (which they did).

Maybe one advantage of buying American-made equipment is the warranty does hold good. I feel we should support the people who do honor them.

Glenn A. Price WA6HYH
Sacramento CA

LAY OFF THE ARRL

My year's subscription to your magazine is coming to its end and I just wanted to comment on the 200th issue and your magazine in general. I like the articles by guest writers — for example, the eye-opening piece on English in the phone bands instead of CW abbreviations and Q sigs. But articles like these cannot outweigh the dislike I have for most of the rest of your magazine.

I subscribed a while back, since I was a new ham and wanted to try more than one of the ham magazines. I responded to your letters encouraging subscriptions and am now sorry I did. I know it's your magazine and I know how you respond to letters complaining about the non-ham articles and I for the most part agree. It's a free press and you can print what you want and what your subscribers want to read. I, however, do not like it, and will not try to change your mind; I will just cease to subscribe. My idea of a ham magazine is a magazine devoted to ham radio. If you have extra space, put in more ham articles. Don't just say that you have just as many or more ham articles and that gives you license for the other subject areas. But, as I said, it's your magazine, and if I don't like it I can go elsewhere.

My main reason for writing is something that has been building since I got your first copy in the mail last year. I cannot stand someone constantly berating other organizations (ARRL). I would be the first to agree that any group such as our group of hams needs suggestions for improvement, but *73* appears to have 20-20 hindsight and very little in the way of active foresight. I most wholeheartedly agree with David Wever's letter on page 9 of issue 200. You complain and condemn, but do not work to improve ham radio. If you would stop the bellyaching about what the League did wrong and get your staff busy on what *73* can do right, I would support you. But since you take the civil-war-in-ham-radio approach, with no compromise and no working together, I am sorry I sent in my subscription fee to help support your magazine's efforts to not help but to harm ham radio. I will not renew my subscription, nor will I recommend *73* to any hams I know — quite the contrary.

I do hope that someday you see the light and really offer something worthwhile to those hams in your camp — and also something to us outsiders who would support another voice if we heard one that was saying something instead of just rabble-rousing.

Allan Olexa WB8YFD
Neffs OH

HELP

Perhaps you can assist me.

I have a close friend whose wife is deaf. She was 14 when she became completely deaf.

She is attractive and very bright, but suffers from being unable to communicate with people, except those at close range whose lips she can read. She speaks clearly and is easy to understand.

I have explained to her about ham radio and the expanded opportunity to talk to others afar with CW. She is quite excited about this prospect.

Do you know any deaf hams she might write? There's nothing like talking to someone who has solved the basic problems. For example, is she better off learning code by "feeling" vibrations in a speaker cone or seeing a blinking light?

Any assistance you can give would be greatly appreciated.

Ervin Jackson, Jr. WB4MQJ
c/o J. B. Ivey and Co.
PO Box 600
Charlotte NC 28230

MORE I/O

An open letter to all hams who read *73:*

Well, you have finally gotten your wish.

Ever since *73* started the I/O section, the letters have been running approximately 2 to 1 *against* the I/O section. These letters probably come from the same people who opposed 2 meter FM, solid state, RTTY, OSCAR, and practically every other important technological development of the past 75 years. As much as you would like to, we cannot return to the good old days of the spark gap and the coherer. However, as a result of your letters, you have achieved one thing: The I/O section of *73* has died. When I subscribed to *73* last fall, I did so for one reason: the I/O section. I have absolutely no interest in ham radio, for I have two other hobbies, computers and photography, both of which require investments in the kilobuck range. As such, I have neither time nor money for another kilobuck hobby. Therefore, with the demise of the I/O section of *73*, I am requesting that my subscription to *73* be canceled, and the remainder of the subscription be applied as an extension of my *Kilobaud* subscription. (Oh, there were 3 articles in the last issue of *73* which were labeled I/O, but these were so heavily ham oriented that I do not classify them as computer articles.)

After all, why should I waste my money on a magazine which no longer runs articles which I have use for, when there are so many other good computer magazines on the market?

And finally, for those of you who say that computers have nothing to do with ham radio, and, as such, have no place in a ham radio magazine, you are absolutely right — but then neither do RTTY, OSCAR, slow scan TV, moonbounce, solid state circuits, single sideband, 2 meter FM, or any of the other specialized aspects of your hobby.

Well, I hope you are satisfied. You have just killed your best hope of attracting me and thousands of other computer hobbyists to your ranks — but that's the way the bits bounce.

Sam Hills
New Orleans LA

I'm sorry you feel that way, Sam. You will be missing many good computer articles which, as you know, do not appear in KB. *— J.M.*

10-4

I am only halfway through your May, 1977, issue, and feel the need to drop the other shoe . . .

Seeing my name taken in vain (page 9) and then in print is too much. Since a ham operator friend of mine (and that's possible for a sidebander) dropped off the issue, I have wondered about a couple of things . . .

I can get along with almost anyone, including most self-righteous ham operators. At the same time, I don't want my sister to marry one — okay . . . 10-fer, good buddy!!

Now, who was it who started the nickname "Chicken Banders"? Who was it who first created TVI, almost before we had television? Who is it who takes credit for many, many React and Alert rescues? Who is it who treats CBers like stepchildren and, in general, puts them down as a bunch of misfits, something like the news media does when two drunks have a shoot-out somewhere and one happens to own a CB radio? I could go on all day, but you old-timers — who got your first call from Marconi himself — probably stopped reading this after the first sentence . . . as is the general case with most open minds . . .

One other "quickie" and I'll get off your frequency. If you high-minded types would boycott any manufacturer who sells ham gear to CBers and, better still, stop buying equipment from any retailer who does the same thing, then both of us would be much happier in the long run . . .

For a lot of reasons, none of the above will happen — and that's too bad — since I think CBers, sidebanders, and ham operators are all bigger and better than the conflict . . .

"Honest John" Beck
Sherman Oaks CA

ROCK CRUSHER

I read with interest K6JQD's comments in the June issue expressing his desire for a universal 250 Watt power limit. Although I now feel, as he does,

that such a limitation would not be a bad idea, the myth that "more is always better" will probably prevail. I must admit that as a relatively new Novice and former CBer, I, too, felt that high power was absolutely necessary for DX work.

My visions of a fancy linear, however, are now fading fast, much to the delight of both my pocketbook and my XYL. In the few months that I've been operating with moderate power equipment and a good antenna system, contacts into Europe and South America have not been uncommon. Reports of my signal as 579 or 599 are the rule, rather than the exception. I've noted that other Novices who are also limited to 250 Watts on the Novice bands have been equally successful. As I am also an Air Force MARS operator, where the output power is usually limited to 400 Watts or less, a 150 Watt SSB signal is more than adequate using nothing fancier than a dipole. QRM is seldom a problem on MARS circuits, and I think the low power restrictions are at least partially responsible. I contrast this with what I've heard on 20 meter phone, and find it hard to tell the difference between a pileup on 20 and CB channel 19.

My "linear vision" has been further shattered with the recent purchase of an HW-7 QRP rig at a local hamfest. Using just a couple of Watts transmitting power, and an allband vertical, I've been able to make contacts in 16 states with signal reports of 559 to 599!

High power . . . who needs it? I've found that some polished operating skills and a little patience far outweigh the lack of output power. Anybody can blast his way toward DXCC. I'd prefer a little more of a challenge!

Keith Baker WD8CMU/AFN8CMU
Wright-Patterson AFB OH

Right on! — J.M.

CODE TAPES ARE FB

Just thought I would let you know how helpful your 13+ wpm code test was during my FCC test. I purchased the tape a little over 1 month ago. I listened to it to and from work 5 days a week for approximately 1 month. I

Continued on page 29

KENWOOD'S NEW TS-520S

AND DG-5 DIGITAL FREQUENCY DISPLAY

A NEW STANDARD IN ECONOMY TRANSCEIVERS

The NEW TS-520S combines all of the fine, field-proven characteristics of the original TS-520 together with many of the ideas, comments, and suggestions for improvement from amateurs worldwide. Kenwood's ultimate objectives... to make quality equipment available at reasonable prices.

FULL COVERAGE TRANSCEIVER
The new TS-520S provides full coverage on all amateur bands from 1.8 to 29.7 MHz. Kenwood gives you 160 meter capability, WWV on 15.000 MHz., and an auxiliary band position for maximum flexibility. And with the addition of the TV-502 and TV-506 transverters, your TS-520S can cover 160 meters to 2 meters on SSB and CW.

DIGITAL DISPLAY DG-5 (option)
The new Kenwood DG-5 provides easy, accurate readout of your operating frequency while transmitting *and* receiving.

OUTSTANDING RECEIVER SENSITIVITY AND MINIMUM CROSS MODULATION
The new TS-520S incorporates a 3SK-35 dual gate MOSFET for outstanding cross modulation and spurious response characteristics. The 3SK35 has a low noise figure (3.5 dB typ.) and high gain (18 dB typ.) for excellent sensitivity.

NEW IMPROVED SPEECH PROCESSOR
A new audio compression amplifier gives you extra punch in the pile ups and when the going gets rough.

VERNIER TUNING FOR FINAL PLATE CONTROL
A new vernier tuning mechanism allows easy and accurate adjustment of the plate control during tune-up.

FINAL AMPLIFIER
The new TS-520S is completely solid state except for the driver (12BY7A) and the final tubes. Rather than substitute TV sweep tubes as final amplifier tubes in a state of the art amateur transceiver, Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity.

HIGHLY EFFECTIVE NOISE BLANKER
An effective noise blanking circuit developed by Kenwood that virtually eliminates ignition noise is built-in to the TS-520S.

RF ATTENUATOR
The new TS-520S has a built-in 20 dB attentuator that can be activated by a push button switch conveniently located on the front panel.

VFO-520 — NEW REMOTE VFO
The VFO-520 remote VFO has been designed to match the styling of the TS-520S and provide maximum operating flexibility on the band selected on your TS-520S.

AC POWER SUPPLY
The TS-520S is completely self-contained with a rugged AC power supply built-in. The addition of the DS-1A DC-DC converter (option) allows for mobile operation of the TS-520S.

EASY CONNECTION PHONE PATCH
The TS-520S has 2 convenient RCA phono jacks on the rear panel for PHONE PATCH IN and PHONE PATCH OUT.

CW-520 — CW FILTER (OPTION)
The CW-520 500 Hz filter can be easily installed and will provide improved operation on CW.

AMPLIFIED TYPE AGC CIRCUIT
The AGC circuit has 3 positions (OFF, FAST, SLOW) to enable the TS-520S to be operated in the optimum condition at all times whether operating CW or SSB.

The TS-520S retains all of the features of the original TS-520 that made it tops in its class: RIT control • 8-pole crystal filter • Built-in 25 KHz calibrator • Front panel carrier level control • Semi-break-in CW with sidetone • VOX/PTT/MOX • TUNE position for low power tune up • Built-in speaker • Built-in Cooling Fan • Provisions for 4 fixed frequency channels • Heater switch.

Specifications

Amateur Bands: 160-10 meters plus WWV (receive only)
Modes: USB, LSB, CW
Antenna Impedance: 50-75 Ohms
Frequency Stability: Within ±1 kHz during one hour after one minute of warm-up, and within 100 Hz during any 30 minute period thereafter
Tubes & Semiconductors:
Tubes ..... 3 (S2001A x 2, 12BY7A)
Transistors 52
FETs 19
Diodes 101
Power Requirements: 120/220 V AC, 50/60 Hz, 13.8 V DC (with optional DS-1A)
Power Consumption: Transmit: 280 Watts Receive: 26 Watts (with heater off)
Dimension: 333(13¼) W x 153 (6-0) H x 335(13-(13-3/16) D mm(inch)
Weight: 16.0 kg(35.2 lbs)

TRANSMITTER
RF Input Power: SSB: 200 Watts PEP CW: 160 Watts DC
Carrier Suppression: Better than -40 dB
Sideband Suppression: Better than -50 dB
Spurious Radiation: Better than -40 dB
Microphone Impedance: 50k Ohms
AF Response: 400 to 2,600 Hz

RECEIVER
Sensitivity: 0.25 uV for 10 dB (S+N)/N
Selectivity: SSB:2.4 kHz/-6 dB, 4.4 kHz/-60 dB
Selectivity: CW: 0.5 kHz/-6 dB, 1.5 kHz/-60 dB (with optional CW-520 filter)
Image Ratio: Better than 50 dB
IF Rejection: Better than 50 dB
AF Output Power: 1.0 Watt (8 Ohm load, with less than 10% distortion)
AF Output Impedance: 4 to 16 Ohms

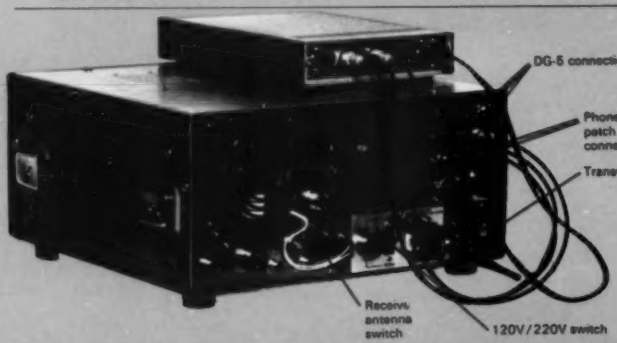
DG-5

SPECIFICATIONS
Measuring Range: 100 Hz to 40 MHz
Input Impedance: 5 k Ohms
Gate Time: 0.1 Sec.
Input Sensitivity: 100 Hz to 40 MHz ... 200 mV rms or over, 10 kHz to 10 MHz ... 50 mV or over
Measuring Accuracy: Internal time base accuracy ±0.1 count
Time Base: 10 MHz
Operating Temperature: -10° to 50° C/14° 122° F
Power Requirement: Supplied from TS-520S or 12 to 16 VDC (nominal 13.8 VDC)
Dimensions: 167(6-9/16) W x 43(1-11/16) H x 268(10-9/16) D mm(inch)
Weight: 1.3 kg(2.9 lbs)

DG-5
(optional)

The luxury of digital readout is available on the TS-520S by connecting the new DG-5 readout (option). More than just the average readout circuit, this counter mixes the carrier, VFO, and heterodyne frequencies to give you your exact frequency. This handsomely-styled accessory can be set almost anyplace in your shack for easy to read operation . . . or set it on the dashboard during mobile operation for safety and convenience. Six bold digits display your operating frequency while you transmit and receive. Complete with DH (display hold) switch for frequency memory and 2 position intensity selector. The DG-5 can also be used as a normal frequency counter up to 40 MHz at the touch of a switch. (Input cable provided.)

NOTE: TS-520 owners can use the DG-5 with a DK-520 adapter kit.



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KENWOOD
...pacesetter in amateur radio

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WHO ELSE BUT KENWOOD CARES ENOUGH TO OFFER FINE AMATEUR RADIO GEAR IN ALL THREE SEGMENTS OF THE RF SPECTRUM . . . *HF, VHF, AND NOW UHF.* EQUIPMENT FOR THE NOVICE JUST COMING UP FROM CB TO THE EXTRA CLASS "OLD TIMER", PORTABLE, MOBILE OR BASE STATION, 2 METER OR 6 METER OR EVEN THE SPECIAL INTEREST OPERATOR WHO WANTS A "KENWOOD" QUALITY 450 MHz RIG LIKE THE *TR-8300**. A DEDICATION TO DESIGNING AND BUILDING THE VERY FINEST EQUIPMENT POSSIBLE . . . A DEDICATION TO INNOVATIVE ENGINEERING BACKED BY A SOLID SERVICE POLICY . . . A DEDICATION TO GIVING YOU MORE SATISFACTION FOR EVERY DOLLAR YOU SPEND . . . WHO ELSE BUT KENWOOD ★★★★★★ *THE PACESETTER IN AMATEUR RADIO.*

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(As of May 31, 1977)

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Phoenix, AZ 85017

ALABAMA
Long's Electronics
3521 10th Ave. North
Birmingham, AL 35234

CALIFORNIA
Gary Radio
8199 Clairemont Mesa Blvd
San Diego, CA 92112
Ham Radio Outlet
999 Howard Ave.
Burlingame, CA 94010
Ham Radio Outlet
13754 Victory Blvd.
Van Nuys, CA 91401
Henry Radio, Inc.
11240 West Olympic Blvd.
Los Angeles, CA 90064
Henry Radio, Inc.
931 North Euclid
Anaheim, CA 92801
Webster Radio
2602 East Ashlan
Fresno, CA 93726

COLORADO
CW Electronics
1401 Blake St.
Denver, CO 80202

FLORIDA
Amateur Electronic Supply
621 Commonwealth
Orlando, FL 32803
Amateur Radio Center
2805 N.E. Second Ave.
Miami, FL 33137
Grice Electronics
320 East Gregory St.
Pensacola, FL 32501

HAWAII
Lafayette Radio Company
1111 Mc Cully St.
Honolulu, HI 96814

ILLINOIS
Erickson Communications
5935 North Milwaukee Ave.
Chicago, IL 60646
Klaus Radio, Inc.
8400 North Pioneer Parkway
Peoria, IL 61614

INDIANA
Graham Electronics
133 South Pennsylvania
Indianapolis, IN 46240
Hoosier Electronics
43 B Meadows Shopping Center
Terre Haute, IN 47802

IOWA
HI, Inc.
1601 Avenue "D"
Council Bluffs, IA 51501

KANSAS
Associated Radio Comm.
8012 Conser
Overland Park, KS 66204

MAINE
Craig Radio Company
Route 1 By-Pass South
Kittery, ME 03904

MARYLAND
Electronic International Service
11305 Elkin St.
Wheaton, MD 20902
Professional Electronics
1710 Joan St.
Baltimore, MD 21204

MICHIGAN
Electronic Distributors
1960 Peck St.
Muskegon, MI 49441
Radio Supply & Engineering
1207 W. 14 Mile Rd.
Clawson, MI 48017

MINNESOTA
Electronic Center
127 Third Ave. North
Minneapolis, MN 55401

MISSOURI
Ham Radio Center
8342 Olive Blvd.
St. Louis, MS 63132
Henry Radio Company
211 North Main St.
Butler, MS 64730
Midcom Electronics, Inc.
2506 South Brentwood Blvd.
St. Louis, MS 63144

MONTANA
Conley Radio Supply
318 North 16th St.
Billings, MT 59101

NEW MEXICO
Electronic Module
601 North Turner
Hobbs, NM 88240

NEW YORK
Adirondack Radio Supply
185 West Main St.
Amsterdam, NY 12012
Harrison Radio Corporation
20 Smith St.
Farmingdale, L.I., NY 11735

NORTH CAROLINA
Frack Radio Supply
252 Patton Ave.
Asheville, NC 28801
Vickers Electronics
500 East Main St.
Durham, NC 27702

OHIO
Amateur Electronic Supply
17929 Euclid Ave.
Cleveland, OH 44112
Srepco Electronics
314 Leo St.
Dayton, OH 45404

OKLAHOMA
Derrick Electronics
714 West Kenosha
Broken Arrow, OK 74012
Radio Inc.
1000 South Main
Tulsa, OK 74119

OREGON
Portland Radio Supply
1234 S.W. Stark St.
Portland, OR 97205

PENNSYLVANIA
Electronic Exchange
136 Main St.
Souderton, PA 18964
Hamtronics
4033 Brownsville Rd.
Trevose, PA 19047
JRS Distributors
646 West Market St.
York, PA 17404

SOUTH CAROLINA
Accutek, Inc.
420 Laurens Rd.
Greenville, SC 29607

SOUTH DAKOTA
Burghardt Amateur Center
124 First Ave. N.W.
Watertown, SD 57201

TENNESSEE
Sara-Rose & Spencer Elec.
1465 Wells Station Rd.
Memphis, TN 38108

TEXAS
AGL Electronics*
3068 Forest Lane #309
Dallas, TX 75234
Douglas Electronics
1118 South Staples
Corpus Christi, TX 78404
Electronics Center
2929 North Haskell
Dallas, TX 75204
Madison Electronics
1508 McKinney Ave.
Houston, TX 77002

UTAH
Manwill Supply Company
2780 South Main St.
Salt Lake City, UT 84115

WASHINGTON
ABC Communications
17541 15th Ave. N.E.
Seattle, WA 98155
Amateur Radio Supply Company
6213 — 13th Ave. South
Seattle, WA 98108

WISCONSIN
Amateur Electronic Supply
4828 West Fond Du Lac Ave.
Milwaukee, WI 53216

*Pending

TRIO-KENWOOD COMMUNICATIONS INC. 1111 WEST WALNUT/COMPTON, CALIFORNIA 90220

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Looking West

Bill Pasternak WA6ITF
24854-C Newhall Ave.
Newhall CA 91321

For eleven years it was known as the Lockheed Burbank Hamfest, a nice little get-together sponsored by the Lockheed Amateur Radio Club/ Lockheed Employees' Recreation Club. I have always enjoyed it, as it gave me a chance to eyeball many of my peers without having to travel a few thousand miles to do so. Each year, though, I noted that it drew more and more attendees and a greater number of exhibitors — in general, it showed a definite growth pattern.

This year, renamed the "12th Annual Los Angeles Amateur Radio Convention" by its sponsors, the old Burbank Hamfest reached the status of a "great one" in your reporter's opinion. Along with Dayton and Atlanta, it truly fulfills the goal it has set for itself: to educate and entertain. Like Dayton and Atlanta, the L.A. convention features exhibits both of manufacturers and of the special interest variety, such as one depicting an early amateur station. Also like both Dayton and Atlanta (and unlike SAROC), there are ongoing symposia on just about any topic that you could dream of. At this convention, the sponsoring organization makes sure that everyone in attendance leaves with a feeling of satisfaction. Moreover, if someone happens to win a prize valued at more than $30, he need not be present to claim it. All prizes whose value exceeds that figure are shipped to the winner. That's a comforting thought when the grand prize happens to be an FT-101E!

You might get the idea that I enjoyed my visit to "beautiful downtown Burbank." It's really more than that. I know a lot of the people involved in putting on this annual show. I have had the opportunity to sit with them and speak with them, and I know full well the measure of total devotion that goes into making each year's Los Angeles Amateur Radio Convention a greater success than the last. It's a convention put on by hams for hams, and the level of pride is evident. Whether you are an avid DXer, an OSCAR enthusiast, or are interested in finding out about the latest equipment available to locate the turkey who's jamming your favorite repeater, you will find something of interest in Burbank. I predict that next year will be even better.

For information on next year's "13th Annual Los Angeles Amateur Radio Convention," write to the Lockheed Amateur Radio Club, 2814 Empire Avenue, Burbank CA 91504.

Who said 220 never has band openings! As I sat here writing this, I received a call via WR6AWQ from Warren Andreasen N6WA/WA6JMM, who related the following: The other evening, while taking advantage of the well-known Southern California "inversion," Warren was in QSO with Lon Albright W6SLF on 223.5 MHz. Lon happens to be located in San Diego, which makes for a 90 mile or so path (which in itself is not bad, especially since Warren's abode is in the center of the San Fernando Valley). Shortly after signing with Lon, Warren noted another conversation on 223.5. It was in Spanish, and each transmission ended with the telltale "crash" of some form of relay device (such as a repeater). Since he neither speaks nor understands the Spanish language, Warren could only make a supposition as to what he was hearing, based upon his beam heading and his working knowledge of 220 activity. His conclusion was that he was hearing the La Paz, Mexico, police department, which operates on 223.5 — and also happens to be about 1,000 miles away. If such was the case, then N6WA/WA6JMM probably holds the unofficial 220 MHz SWL DX record, thanks to a hand from Mother Nature.

Month after month I keep forgetting to do something, so before I forget again, here goes. Question: What's an FM-144DX? Answer: It's a mistaken nomenclature for what is really an FM-28, manufactured and distributed by Clegg Communications. The real question, still unanswered, is how I came to make the mistake in the first place. To date I do not know. My notebook from SAROC is chockfull of goodie information gathered, and includes the notation "New Clegg 2 meter radio — FM-144DX — refer pictures two and three roll B." However, after submitting the article for publication, I happened to call Ed Clegg to set up an interview appointment for an article soon to appear in this magazine, and he informed me that my model designation is not exactly the correct one. Even funnier, since the article had already appeared in print, he was receiving inquiries as to what an FM-144DX was. To compound matters, I mentioned the whole thing to Bill Orenstein KH6IAF (who happened to spend a lot of time playing with the radio at SAROC) and he confirmed again what Ed had already told me on the telephone.

Three weeks later, along with Larry Levy WA2INM, I was in Ed's office holding in my hand the very same radio that I had played with at SAROC — clearly it reads FM-28. How and where I ever came up with "FM-144DX," I will never know. I am going to "cop out" on this one and blame it on too much Las Vegas night life or something like that. However, those of you who already own one of these beauties know that I was correct on two points: It is a radio that does everything the advertisement promises, and it's available at a price most any ham can afford. It also happens to be backed by one of the finest and most reputable manufacturers in the amateur radio field today: Ed Clegg W3LOY. That in itself means a heck of a lot!

Many of you write to ask why I do not spend time discussing all the rulemaking proposals flowing forth from the FCC in Washington. It's simply a matter of publication lead time. What you are reading today was written at least sixty days ago, and any discussion of pending legislation written now would be a moot point by the time you read it. However, here is a brief synopsis of the points I covered in my official replies to a few of the dockets and RMs.

On repeater/remote deregulation, I felt as follows: (A) The Commission must realize that a specific difference exists between the concepts governing a repeater and those governing a remote base. While the hardware might be similar, the methods in which they function are totally dissimilar and the purpose and/or objective of each is different. (B) Remote bases must be considered as a separate entity, and regulations governing such operation must be separated from those governing repeaters — to give the remote owner the freedom necessary to experiment and thereby advance the state of the art. (C) While repeaters are an important entity, they are but one aspect of VHF/UHF operation. Therefore, I favor retention of repeater sub-bands on certain of our bands to protect non-relay format interests that share the spectrum from encroachment by relay format communication. However, on ten and six meters I favor total deletion of sub-bands, to stimulate activity in that spectrum and to relieve the overcrowded conditions on two and in

Burbank's not as big as Dayton, but it has a good flea market nonetheless.

Is it the 1920s? No— it's W6HS exhibiting an amateur station of that era at the 12th Annual Los Angeles Amateur Radio Convention.

places on 220 and 450. In regard to ten meters, I requested that the Commission act to give Technician class licensees radiotelephone privileges for that band (specifically, narrowband FM, again to help stimulate growth on ten and as a method of preventing encroachment by the "HF" – read that as unlicensed CB – crowd). Sub-bands do provide a significant value on two, 220, and 450, where both relay and non-relay communication share significant amounts of spectrum, and with slight expansion to both two and 450, I favor retention of sub-bands there. (D) I favor deletion of the need for specialized auxiliary link, control link, etc., licenses; I agree with the concept of one license with most privileges contained therein. However, I do favor retention of the specialized repeater license (along with its specific "WR" designation). Having the blanket right to erect and operate a repeater inherent in every amateur license could, and probably would, lead to a multitude of unsanctioned and uncoordinated repeaters, and would thereby lead to an overall degradation of the amateur service. (E) I requested that all deregulation along these lines be instituted on a specific time schedule over a period of two years, with the most pressing problem, that of remote base deregulation, taken care of immediately. (F) Amateurs could prove their ability to administer their own affairs through the formation of a National Voluntary Band Planning Council, made up of elected officials representing each area, mode, and special interest, which would develop lines of communication to the FCC for the purpose of providing feedback to the Commission as to how well deregulation is progressing. Such a council would, in effect, replace FCC regulation with voluntary self-regulation.

In a nutshell, that's a brief synopsis on repeater/remote deregulation. If this were 1969 or 1970, I probably would be looking at this a lot differently. However, this is 1977 – there are over 3,000 systems on the air and many places such as L.A. have plumb run out of room on two and 220. We now face a threat to our spectrum from those who flaunt the law and are slowly inching their way toward 10 meters. If we are to survive and prosper, we must "get it all together" – get off our individual ego trips and make deregulation work toward our own advantage on a collective basis.

It would be nice to say "take all the rules away today," but in reality any society without some form of governmental structure is sure to crumble. History more than proves this out. To many of us, amateur radio is more than just a hobby – it's a dedication in our daily lives. While some of the views I expressed in my reply comments on this matter may not be popular, I believe that they make sense in that they systematically lead to a transfer of power from governmental regulation to self-regulation, and provide some semblance of protection for the sanctity of our spectrum.

De WA3ETD

John Molnar WA3ETD
Executive Editor

CONTEST RESULTS

The results are official! The *"73* Call For Papers" competition ended on May 15 with many entries. You may recall that the intent of the writing contest was to discuss one of the many facets of ham radio in an article appealing to the beginning enthusiast. The articles submitted encompassed subjects ranging from contest operating to the conversion of old receivers. The winning article is by Richard R. Parry. His effort, "So You Want To Get Into RTTY," explains radioteletype in concise, easy to understand terms, and is loaded with pictures and diagrams. Richard's article will appear in the September issue of *73*, an issue devoted to RTTY. Look for it. Congratulations, Richard, and thank you for the other articles, authors! They will be considered for publication and processed normally.

Speaking of special issues – keep your eyes on *73* for the next few months. As you can see, the August issue features antennas and related subjects. Summer is the time to build antenna systems. Hopefully one of the feature articles will provide the stimulus to build the system you've been putting off "until next weekend." Once the antenna farm is complete, you will need some gear for the shack; why not try a new mode? More and more hams are getting into RTTY – give it a try! The September issue will feature RTTY, and some super articles are on tap. Everything from message generators to computer-controlled TUs will be covered. No one remotely interested in RTTY will want to miss this issue! November is OSCAR 8 (AOD) time; that means time for another *73* OSCAR special issue. Our last satellite special (July '75) was a sellout – don't miss this one! About your subscription – don't let it expire now, not with three blockbuster specials coming. Send in the renewal card, and make sure your friends do the same – if you lend one of the special issues, the chances of never seeing it again are good!

CB TO 10

The response to the continuing series of CB to amateur conversions has been fantastic. We presented several "band plans" in hopes that reader response would allow us to promote one of them. Check Ray Barnum's plan (June '77) and Wilder's (May '77) and let us know which you favor. Several additional conversions are on the press. Some readers have indicated a problem with information provided in Bob Wilder's article, concerning the Cobra conversion. It appears that a simple crystal switch will not effect the desired change. Refer to "Letters" for information by WB3CJI concerning the Cobra modification. Watch for additional CB to amateur band articles.

TIPS FOR AUTHORS

I have several suggestions to pass along to present and future *73* authors. Most of the submitted manuscripts look good; however, a few problems prevail. Please type your effort! After reading several dozen letters, product releases, articles, and reviews, a handwritten manuscript can be murder. Most are sent back for typing. Editor's eyesight aside, there are practical reasons for typing. Our typesetter must produce magazine type directly from your manuscript – why make her guess at the handwriting, especially in a technical article?

Photographs: Good pictures make a fine article better and increase the size of your check. Please do not send Polaroids or Instamatic shots. The photos you send are converted directly into magazine pictures (halftones); thus the original quality is important. We would like 5 x 7 black and white pictures if possible. Negatives are not required – keep 'em in your file.

Please write your name, address, and call on each manuscript page and photo. This allows us to keep track of your article.

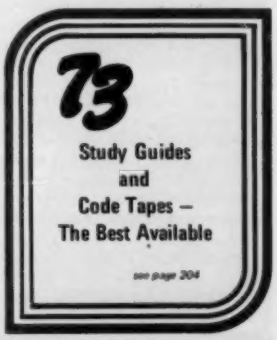
TIPS FOR READERS

Several authors have complained about receiving large volumes of mail concerning their *73* article. This is fine and to be expected, but when requests for information come without an SASE, it's a bit much! Imagine receiving fifty questions about an article and having to provide fifty stamps and envelopes, as well as the time required to answer queries. The SASE is a required courtesy when corresponding with authors. Give them a break! The same applies when writing *73* for information. We are not really equipped to answer technical correspondence – that's what "Ham Help" is for; however, we do our best when possible. SASE is required!

NEW TRENDS – 10 GHZ BECOMES ACTIVE

My experiments with the Gunnplexers by Microwave Associates are continuing. The microwave front end requires a 30 MHz i-f and FM detector to function, as well as power and control voltage. Modulation is applied to the Gunn oscillator by coupling audio to a varactor diode which is an integral part of the transceiver. A number of schemes can be used for the 30 MHz i-f. My system consists of VHF Engineering receiver modules and a home brew 30 MHz to 10.7 MHz converter. The VHF modules are a natural for the application, as a complete receiver can be custom-tailored using the receiver strips. I will describe my system in detail in a month or two. If you have done any experimenting with microwaves or Gunnplexers, let me know. Many *73* readers are interested in UHF and microwave experimentation; if you're already into something, pass along your knowledge to the beginners!

Concerning UHF: I made a trek up Pack Monadnock Sunday, loaded with gear for 432-450. The rigs consisted of the Icom 30A FM transceiver, KLM Echo 70 SSB combo, and the VHF Engineering BLE 10/80 power amp. The UHF antenna was the KLM 27 element log, which allowed operation from 432 to 446. The DX results were a bit discouraging. I guess not many people sit around on Sunday afternoon monitoring 446.0 simplex, as only a few stations were worked. I did discover a large crop of repeaters up there, and activity was light. If anyone needs New Hampshire on UHF, drop me a line and we can set up a sked, either on 446.0 or 446.5 FM, or on SSB down below. I have the capability to stack another 27 elements, and should be able to work into New York if someone is on the other end. If you have not tried UHF, you're missing something – especially if the requirement for dependable line-of-sight communication or control is present. Authors take note – your UHF articles will be well received. Keep the beginner in mind when you start writing about UHF and microwaves! Have fun and keep us posted!



RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Last month I described how letters, figures, and special machine functions are encoded for dc transmission. Recalling that all characters are represented as five pulses, this month we will investigate techniques for sending encoded information by radio.

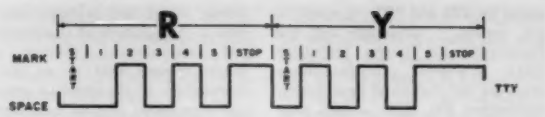
A CW transmitter can be keyed directly by the TTY pulses. The result is called "ON-OFF" keyed RTTY. Fig. 1 illustrates this technique. Subsequent figures are also grouped here for comparison. ON-OFF keying was, in fact, the earliest method used to transmit TTY over the air. Advantages are related to simplicity in transmitting: Merely hook the TTY to the key jack! Receiving is also easy, and reception techniques for all modes discussed will be covered in a subsequent column. Disadvantages relate primarily to interference susceptibility and fading. A nearby CW signal can wipe out an ON-OFF TTY station, and fading can remove whole letters.

A better way to send TTY is by presenting a constant signal for the MARK state, and changing it in some way for representation of the TTY signal. Changes may be introduced in amplitude, frequency, or by a superimposed modulating waveform. Direct amplitude modulation with the TTY approximates ON-OFF keying, with all its attendant flaws. Some fancy forms will be discussed at the end of this column, but the two most used ham methods are FSK and AFSK.

In FSK, frequency shift keying, a carrier is shifted in frequency to correspond to MARK and SPACE. Fig. 2 diagrams this nicely. This system, as are all to follow, is a redundant system. That is, information is obtainable by looking at either MARK or SPACE, even in the absence of either one. (Remember that in ON-OFF keying, if you lose the SPACE, you have a steady MARK, and if you lose the MARK, you have nothing.) Transmission of FSK is accomplished by shifting the transmitter vfo in step with the TTY, and reception, by decoding either or both the MARK and SPACE. Done properly, this system is very immune from interference, and, since fading normally affects only one of the MARK or SPACE frequencies at a time, proper use of the built-in redundancy makes fading no problem either. The frequency shift involved may be anything from kilohertz to fractions of a Hertz, which might be more properly called "phase shift." In amateur circles, "standard" shifts are 850 Hz (wide, old) and 170 Hz (narrow, new).

Unfortunately, FSK presumes very stable transmitters and receivers. The level of shift is less than one kHz, and drift in the vfo of any significant degree would be intolerable. VHF transmitters, especially early ones, could not maintain this degree of stability. Use of an audio tone, shifted in frequency in a manner similar to FSK, became the standard on VHF links. Take a look at Fig. 3. This AFSK is more useful than it appears at first glance, and some of its uses will be covered in future columns.

Finally, as promised, some erotica — I mean, exotica! What if I send a pulse during each 22 ms "window" representing a TTY bit? By changing the pulse's amplitude or position within the window, I could encode MARK and SPACE with a decodable system. Fig. 4 shows what I mean. Such Pulse Amplitude Modulation (PAM) or Pulse Position Modulation (PPM) is not used much in the amateur service, but it is neat, huh?



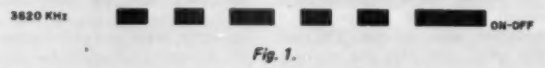


Fig. 1.

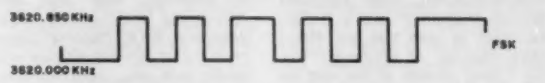


Fig. 2.

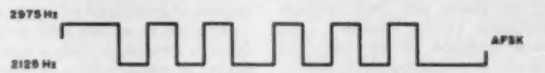


Fig. 3

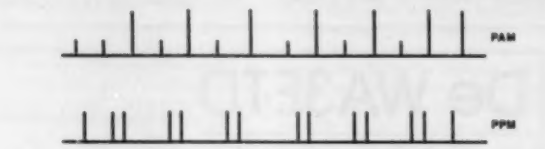


Fig. 4.

Next month we will discuss the hardware necessary to receive a RTTY signal. Details concerning the Model 15 printer will be provided, as that machine is widely available at reasonable prices. If you are interested in getting started in RTTY, it would not be a bad idea to shop around for a usable Model 15. The machines are available at flea markets, as well as through commercial sources. Details will be provided in future editions of the RTTY Loop.

NEW ENGLAND RTTY REPEATER

Best of luck with "RTTY Loop"! I hope it will be a success. You'll be hearing from me from time to time as I am an avid RTTYer. I'm also net control for a local 2 meter TTY net. We meet each Wednesday at 9 pm on 147.69/.09 (WR1ABN) at 60 speed, 850 Hz shift. We exchange pictures, and a couple of the boys have microprocessors which we play with on the air. Perhaps you could mention us in your column and help "spread the word."

Dick Peters WA1PWF
27 Lafayette Lane
Norfolk MA 02056

If your group is involved in a unique RTTY application, let 73 know. Keep your letter short. Each month, space allowing, we will publish as many letters as possible. — J.M.

Ham Help

To Whom It May Concern: HELP!!

I have been trying to get into SWLing for the past year now and have been frustrated at every turn. I have studied the equipment catalogs and such and the prices have taken me aback somewhat. I do not know what equipment can be had that will do a good job and keep within a self-imposed $300.00 budget. Yesterday I picked up your mag (the first one I had ever seen!) and found it helpful. Your article on receivers was outstanding! But alas, where might I find excellent used quality equipment at a good price?

My knowledge of antennas is kaput for the present. The space I have for an antenna is severely limited except for the possibility of a longwire type. I am not familiar with any other type I can use.

Sorry if I have sped a deluge of questions your way, but I'm a babe in the woods not wanting to be taken at every turn and wanting to learn more about this new-found hobby. I am currently limited to a GE 10-bander my wife bought me last year for my birthday and hence my interest was born!

Any and all help will be deeply appreciated.

Robert B. Goltare
4100 N. O'Henry Blvd.
Box 126, Oakwood Forest
Greensboro NC 27405

I am a freshman college student who is majoring in Electrical Engineering and is disenchanted with Citizens Band radio communications. I currently hold only a CB license, but I am independently studying on my own for the Technician license so that I can operate on 2 and 6 meters. I would like to meet, contact, or correspond with amateur radio operators or clubs in my area who can fill me in on local testing procedures, 6 and 2m radio communications (especially repeater operations). I would also like to know if there are any clubs or schools giving Morse code classes.

I also need a schematic for the Heathkit 6m transceiver (HW-29), the original which has only 4 tubes (6AU8, 6AN8, 12AX7, and 6AQ5), not the later type of the same model which has an additional suffix "A", as in HW-29A, which is the only schematic I was able to obtain from the Heathkit Co.

Raymond Tom
1646 West 87th St.
Chicago IL 60620

You sure have a fine magazine there, especially since it gives everyone an equal chance to voice an opinion whether you there at the plant agree or not.

Well, this letter is not meant to mound praise on your magazine, even though it is a very good one, but to ask you if you would please place in ham help that I am looking for alignment info and a schematic to photocopy for a Heathkit AR-3 and a Bendix FM transceiver converted to two meters, model no. MRT-6FB.

Your diversification will keep your magazine on my renewal list. Again, thanks for a very fine magazine.

Robert D. Houlihan WB9WPE
497 E. Second St.
Galesburg IL 61401

I need an instruction manual and schematic for a Gonset Communicator IV 6 meter AM xcvr, model #3342. Will buy or copy.

Bill Fletcher WB9UYE
Rt. 1, Box 190-B
La Crescent MN 55947

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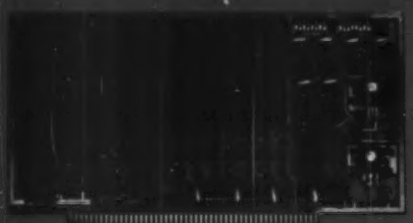

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- Solder masked on both sides of PC Board.
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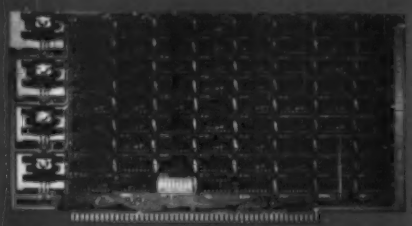

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EDITORIAL BY WAYNE GREEN

from page 4

and is pioneering microcomputers in Japan. The circulation of his *I/O Magazine* is already over 20,000, so it probably won't be long before we start seeing some computers coming over from Japan to compete with our homegrown products.

We cooked up a little deal where Nishi will be importing *Kilobaud* and distributing it in Japan, complete with an inserted section which translates the gist of the articles into Japanese.

Nishi flew over from Tokyo for the Los Angeles Personal Computing show in March ... and again for the San Francisco Computer Faire in April. He made it for the National Computer Conference in Dallas in June, too ... and will be here for COMPUTER-MANIA in August. Computer commuter.

I/O Magazine is aimed at the newcomers to computing, much like *Kilobaud*. Nishi is just getting a second magazine started ... *ASCII* ... which will be aimed at the higher level computerists.

In Japan, as in the U.S., a substantial percentage of the computer hobbyists came into the field from amateur radio. We'll be getting some of the I/O articles translated for reprinting in *73* and in *Kilobaud*.

Nishi writes a short program into the ISC microcomputer on Wayne's desk.

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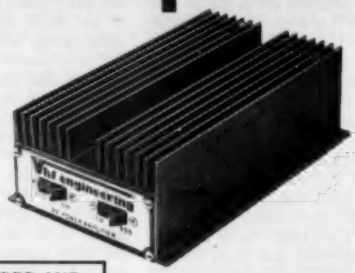

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BLC 10/150	144 MHz	CW-FM-SSB/AM	10W	150W	259.95
BLC 30/150	144 MHz	CW-FM-SSB/AM	30W	150W	239.95
BLD 2/60	220 MHz	CW-FM-SSB/AM	2W	60W	159.95
BLD 10/60	220 MHz	CW-FM-SSB/AM	10W	60W	139.95
BLD 10/120	220 MHz	CW-FM-SSB/AM	10W	120W	259.95
BLE 10/40	420 MHz	CW-FM-SSB/AM	10W	40W	139.95
BLE 2/40	420 MHz	CW-FM-SSB/AM	2W	40W	159.95
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Output Current: 30 amps (50% duty cycle)
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Weight: 25 lbs.
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Dentron Radio represents the kind of American success story you often read about. It began just three years ago in a basement workshop, but Dentron today occupies a modern plant with over 60 employees. Dentron products are in use all over the world in applications just as varied as the languages of the customers. The company has made its name on tuners and antennas, not to mention the 160m transverter that Dennis Had KBKXK designed and built in his Ohio basement workshop three years ago.

The company has taken a different approach in developing its product line than most. They've gone from the transverter and matching antenna tuner to a complete line of antennas (fully assembled and ready for installation as they leave the factory), a complete line of tuners, to amplifiers, and, before year's end, to HF transceivers. There has been a refinement process along the way, and with each new product, Dentron has opened another door, another market.

With the introduction of the MLA-2500 amplifier, for example, the company found itself swamped by orders from (among others) the US military (SAC), foreign government and commercial interests, the medical research community (which uses the MLA to produce rf at continuously controlled levels for cancer treatment), the welding industry, researchers probing the separation of iron ore, HF satellite ground linking, and, of course, the amateurs for whom the amplifier was designed in the first place.

Demand for the MLA has far exceeded supply at Dentron dealers across the country, and it is expected that that situation will continue for some months to come. (By the time this issue reaches you, however, availability should be up.) But why do so many people want MLAs? Read on.

The MLA-2500 weighs just over 45 pounds (including full duty built-in power supply), measures only 5 inches high by 14 inches wide (about the same width as the popular Heath SB-200 1200 Watt amplifier) by 14 inches deep. The MLA is surprisingly small in size for an amplifier of its class (2000 Watts in the amateur service, 2000 plus Watts in commercial and military service), and runs as if the 8875 finals were somehow water-cooled, instead of by forced air. It is significant to note that at no time in more than two months of testing did the MLA ever reach more than a "warm" temperature; that is, the MLA actually ran cooler than any other piece of station equipment (exciter, receiver, scopes, and so on). Not even after an afternoon of SSTVing on 20m was the MLA observed to be abnormally warm, and the main comment from visitors to the shack (aside from finding the aesthetics of the amplifier very pleasing) was how surprised they were that the unit ran so coolly. As can be seen in the photograph, nearly all of the system's cooling action is directed towards the tubes and associated output stages, while the power supply, control, and relay boards must rely on circulated air, independent of the forced air system on the 8875s. A dual speed cooling system is used, with automatic override of the slow speed function when tube plate temperatures approach unsafe levels (over 200 degrees C). Even that automatic function can be overridden through a "continuous duty" feature, which locks up the cooling system at maximum. Dentron recommends use of the MLA in a tilted-up position, through the use of a hinged bail between the front feet. A 19 inch rack panel mounting kit is also available.

Another reason for the MLA-2500's quick acceptance and popularity is performance. It takes only 36 Watts of drive to produce a full kW input (or 65 Watts to yield 2 kW PEP for SSB operation) on 160 through 10m. Efficiency, according to checks with an outboard Bird monitor, is outstanding, with over 700 Watts out at 1 kW input, making for 70% efficiency. (Lab tests showed that the MLA's efficiency went up with increased power inputs; e.g., at 1336 Watts dc input, the MLA yielded 1000 Watts output, for an efficiency figure of 74%.) At 1 kW input, then, the MLA is running at less than half its capabilities, thus accounting for its remarkable tendency to run very quietly and coolly for hours, even days, on end. It would be fair to say that the MLA is well suited for contest operations, and our tests certainly prove that to be true.

The Dentron MLA-2500 160-10m linear amplifier. The MLA offers modular construction, with a two step forced air cooling system.

The power supply is one of the MLA's unique features. Offered standard is a low profile 24½ pound transformer designed especially for the MLA. On rural mains, the MLA produced 2300 V worth of plate voltage. A rear panel cover allows access to line fuses and the transformer primary taps for switching between 234 and 117 V ac service, although 234 V ac 15 A service is recommended for this class of amplifier. An important note here is that the MLA produces extremely high voltages, and must be treated with care. Aside from a direct line for the 234 volt service, sufficient grounding is important, and no attempt should be made to defeat Dentron's circuit breaker system, which cuts all voltage to the unit if the covers are removed. The Operating Manual recommends waiting at least five minutes before getting into the unit for cleaning or adjustment, so that the electrolytic capacitors have fully discharged through their bleeder resistors. As with all the other circuitry in the MLA, the power supply is modularly constructed, allowing for easy removal of the associated boards for service.

Tuning the MLA is made easier because Dentron used twin 3 inch meters, one for output in Watts, the other a multimeter for measuring plate voltage, current, and grid current. Whether the MLA is "in" the line or not, the output meter functions, so it is easy to tune your exciter and antenna tuner for the specified drive and flip the amplifier into the line for final tuning. There is little doubt in tuning the MLA; it's an easy, quick process of tuning and loading up to the desired power input. One cannot forget, however, that the MLA is *designed* to be run far from its maximum limits, not unlike a finely tuned sports car capable of much more than the 55 mile per hour speed limit. Enough said?

To account for the easy tuning of the MLA, one only has to check out the tank circuitry. Dentron tried a number of different designs, including silver-plated copper tubing, but found a teflon covered conductor of 19 silver-plated wires worked the best. Dentron engineers discovered that their design allowed for closer windings, thus improving harmonic suppression, which is rated by the factory at better than 55 dB at full power on all bands. There is also the side benefit of extra protection from the use of teflon. Dentron says tests show that the system is especially good in high humidity or salty environments.

Shipped from the factory, the MLA comes in two cartons — one for the main unit, and a smaller package for the 8875 finals, the delay tube, and plug-in control relay. All four devices are easy to install after removing four top cover screws and the cover itself. If you carefully follow the instructions in the MLA Operating Manual, the 8875s will go in easily, but due to their short, narrow pins, it can get a bit tricky. Best idea is to follow the manual!

All adjustments, wattmeter, ALC, and power transformer taps, are accessible without removing the MLA's covers. All controls are factory aligned, and I did not find it necessary to readjust them. Operating the MLA, in fact, was about as troublefree as possible ... there really wasn't a glitch encountered during our test period.

Operating the MLA is very satisfying. One of our editors put it this way: "Using the MLA-2500 in conjunction with my Heath HW-101 was one of the most pleasant experiences I have had in ham radio. It was nice being told over and over again that I had one of the best and strongest signals on the band, be it 40 meters or 15. This was all done with the use of only dipole antennas, so there was little that could be credited with the great signal strength reports except the amplifier. The MLA is also very easy to operate; in fact, it is so easy to use that at first I thought I must be forgetting something. I wasn't, however, because the signal was very definitely there."

My use of the MLA began with the last ARRL DX phone weekend, and its performance left me reeling. Using wire beams, slopers, and dipoles, I worked non-stop for the entire weekend without once turning off the MLA. Nearby stations running multi-element antennas checked with me several times to confirm I was running wire antennas, and one fellow actually came over to see for himself. (I attribute that mostly to the fact I'd been running substantially less power in the past.)

Power, especially when you're dealing with an amplifier like the MLA, can get away from you. I found myself running the amplifier for the sake of running it, instead of saving the power for when it was truly needed. After the excitement had worn off to some extent, I began to spend more time on CW, running 100 Watts or so on first calls, and then switching to the MLA for ego recovery purposes. It never missed!

On SSTV the MLA was a great improvement over the SB-200 mentioned earlier. Picture quality was reported much less susceptible to QSB and QRM, in direct comparison to the smaller amplifier. The interesting thing was that the MLA, running twice the power continuous duty, ran much, much cooler than the SB-200.

Considering what's ahead from the FCC, it appears the days of the super-amplifier may be numbered. Amplifiers like the MLA, which offer high power capability at a moderate

The KLM Echo 70cm transceiver.

price (and thus can be operated conservatively for longer component life), are coming into vogue. Pending FCC proposals may force future MLAs to cover only 160 through 15m, but the basic machine will remain the same. It is a highly efficient, very compact, full power linear amplifier that at $799.50 costs less per Watt than any amplifier manufactured anywhere. For a while, you may have a hard time finding an MLA-2500 at your local dealers . . . but on the basis of our experience, it's well worth the wait. *Dentron Radio Company, 2100 Enterprise Parkway, Twinsburg OH 44087.*

Warren Elly WA1GUD
Bennington NH

USER IMPRESSIONS OF KLM ECHO 70CM SSB UHF TRANSCEIVER

Are you ready for the Phase III OSCAR satellites? If you are an amateur satellite enthusiast, you probably know that the new series of birds will be the first to use an assigned amateur satellite band: 435 MHz. The first of the orbiting repeaters is due to be launched within nine months. The satellite will carry a two meter to 435 MHz transponder, which will require the Earth station to have UHF SSB receive capability. (Recall that the existing OSCAR 7 satellite *receives* on 432.) The only known commercial rig that offers 435 MHz SSB capability, as well as other functions, is the Echo 70cm, by KLM Electronics.

Many OSCAR 7 Mode B users are already familiar with the Echo 70. This ten Watt transceiver allows SSB and CW communication on the 432 and 435 MHz amateur bands. It has many features that should appeal to the UHF enthusiast. Let's take a quick look at the transceiver, starting with front panel controls. The predominant feature of the rig is a large, center-mounted knob calibrated from "01" to "47" in increments of two. These numbers correspond to 20 kHz increments in frequency, with an implied starting point at either 432.01 or 435.01 MHz. This allows a tuning range of 480 kHz in each band. Continuous coverage within each 20 kHz segment is provided by a normally centered vxo control. The vxo range on either side of zero is 10 kHz — thus the entire segment can be continuously tuned. Additionally, an RIT control is provided to clarify received SSB signals. The range of the RIT is about 2 kHz. Squelch and volume controls are mounted on the right side of the panel, with the power switch connected to the volume control.

Three push-button switches are mounted on the left side of the main tuning control, under a dual purpose meter. This meter is calibrated in S-units when receiving, and provides relative power output when the rig is on the air. One button selects upper/lower sideband. The second engages an impulse noise blanker when activated. The third switch allows any 20 kHz band segment to be continuously swept for the presence of signals. The "Auto Watcher" is most useful when the Echo 70 is being used for point-to-point Earth communications. It is only necessary to know which 20 kHz is going to be used — the scan will pinpoint the signal. The presence of the "Auto Watcher" scan is denoted by a small red lamp which is illuminated during the function.

The back panel also contains several controls. A slide switch selects the base frequency of 432 or 435 MHz. A second slide switch determines the mode of the transceiver — either SSB or CW. A final control selects the internal vfo, or allows an external device to be used. When in external mode, the panel lamp on the main tuning dial is extinguished. Jacks for key, vfo, relay, and speaker are also provided. Power for the Echo 70 is a nominal 12 V dc. KLM provides two power connectors and fuses for the rig, allowing one to be permanently connected in an auto. The antenna connector is a standard SO-238 UHF jack.

I have operated the Echo 70 on SSB, CW, through OSCAR, and on simplex. Unfortunately, there are not many stations in New England on 432 SSB, so a test had to be arranged. Receive and transmit audio quality is crisp and clear, and the vxo operates in a smooth, linear fashion as the signals are tuned. The receiver consists of a double conversion design, front-ended by a six cavity helical resonator and FET amplifier. Overload was no cause for concern, as I operated the Echo 70 in the presence of an 80 Watt signal at 446 MHz and a two meter transmitter without any problems. One unexpected bonus was obtained from the receiver. I was tuning a 2m SSB transmitter, and was able to copy the third harmonic on the Echo 70. I am sure that KLM did not design the transceiver to be used as a test instrument, but of course one must use what is available!

The transmitter section delivers better than 10 Watts into a 50 Ohm load, as measured on a Bird Model 43 wattmeter. This was sufficient to access OSCAR 7 using a home brew turnstile antenna system. The 10 Watt output is more than enough to drive an outboard amplifier for extended DX or OSCAR work.

The Echo 70 only draws five Amps under transmit, so an existing 12 V supply can probably be used to power the rig. The transceiver is a natural for OSCAR satellite work. It has the versatility to operate with existing and future birds, as the Phase III satellites will use the 435 MHz band. If you are interested in greeting the new OSCAR when it is launched, the Echo 70 is a natural! While you are waiting for the launch, look for me on OSCAR 7, Mode B. I would also be happy to arrange a QSO on 432 SSB or CW from our local test mountain.

At $495.95, the Echo 70cm is complete with microphone, internal speaker, two power cords, mobile mounting bracket, and spare lamps and fuse. *KLM Electronics, 17025 Laurel Rd., Morgan Hill CA 95037.*

John Molnar WA3ETD
Executive Editor

NEW FREQUENCY COUNTER/GENERATOR

A unique new frequency counter/generator has been announced by Lunar Electronics. The model DX-555P is a basic 30 MHz counter with 5 digit display and 7 digit readout (with front panel scaling). The 10 MHz timebase, which includes easy zero adjust to WWV, exceeds most accuracy requirements. The built-in prescaler extends the frequency count range to 300 MHz, and is activated by a rear panel switch.

The unique part of the unit is the variable frequency marker oscillator, covering 440 kHz to 30 MHz in 3 bands. When the marker oscillator is activated by its front panel switch, its output is both available from a rear panel jack and displayed on the counter readout. The output of the marker oscillator, which also may be AM modulated with a 600 Hz tone, is of sufficient strength to align receivers down to the 455 kHz i-f and up through 30 MHz. The marker oscillator, which also includes a front panel fine tune adjust, serves as a highly accurate and economical frequency source in lieu of much more expensive frequency synthesizers.

Uses are innumerable, including the many varied counter applications through VHF and CB. The marker oscillator allows alignment of receivers in the HF spectrum, including their 455 kHz i-fs. The high harmonic output of the marker oscillator may also be used through the lower VHF range with careful attention to frequency, which will preclude aligning on the image. SWL users can easily set their receivers to the frequency listed for a foreign broadcast station without having to hunt across the receiver's usually inadequately accurate dial for the station of interest. Besides the SWLers, CBers, and bench technicians mentioned above, other users would include radio amateurs, experimenters, field technicians, and many others.

The model DX-555P counter/generator with prescaler lists at $239.95. The unit is also available without the prescaler at $189.95. Units may be obtained via dealers, or direct from Lunar Electronics. *Lunar Electronics, PO Box 82183, San Diego CA 92138.*

THREE NEW COUNTERS FROM YAESU

The introduction of a new line of three frequency counters, designated as YC-500, has been announced by Yaesu Electronics Corporation. The three models offered are the YC-500J (with an accuracy of 10 PPM), the

The Lunar Electronics DX-555 counter.

The Yaesu YC-500J frequency counter.

YC-500S (at 1 PPM), and the YC-500E (at 0.02 PPM). All three counters provide six display digits and cover the range of 10 Hz to 500 MHz. Two separate inputs are provided, one covering 10 Hz to 50 MHz, and the second, 50 MHz to 500 MHz.

A built-in ac or dc supply provides for complete portability. Advanced IC techniques are used in the circuit design, and a double-sided computer quality circuit board ensures stable and extremely accurate operation for many years.

The counters are now on display at all authorized Yaesu dealers throughout the United States. A copy of the operating manual may be purchased for $4.50 postpaid from *Yaesu Electronics Corporation, PO Box 498, 15954 Downey Avenue, Paramount CA 90723.*

NEW HUSTLER AMATEUR ANTENNA CATALOG

A brand new catalog describing the entire line of Hustler amateur HF, VHF, and UHF antennas has just been published by New-Tronics Corporation in Cleveland, Ohio. New-Tronics is the originator of the Hustler brand of amateur and CB antennas.

Hustler's new amateur antenna catalog contains more than 40 antennas and accessories. Featured products include the new no rip-off "Hustloff" trunk lip mount that does not require drilled holes. A turn of a knob removes or mounts the entire antenna assembly on the side or edge of a trunk lid, all without disconnecting the cable. The antenna assembly stores easily inside most trunks. Test data shows that the solid grounding of the "Hustloff" mount provides the user with consistent performance under any conditions — plus far greater range potential, compared to other available rob-proof mounts (including the magnetic and hinged flip-out variety).

Another featured item is the improved performance built into the base-loaded 5/8 wavelength BBLT and BBL series of two meter mobile antennas with 3.4 dB gain (compared to a 1/4 wave ground plane).

Other products include a fixed station four band vertical antenna (one setting for 10, 15, 20, and 40 meter coverage), a fixed station two meter vertical with 6 dB gain (compared to a 1/2 wave dipole), and a variety of mobile antennas for 2, 6, 10, 15, 20, 40, 75 and 80 meters, as well as 140 to 500 MHz operation.

A copy of Hustler's new amateur antenna catalog is available by writing to: Sales Department, *New-Tronics Corporation, 15800 Commerce Park Drive, Cleveland OH 44142.*

NEW SMALL-SHANK ELECTRONIC TECHNICIAN DRILL

Wahl Clipper Corporation has introduced a compact electric drill that accommodates drills and burrs with a shank size up to .123 (1/8"). The ISO-TIP electronic technician drill is ideal for prototype development, circuit board revision and redesign, solder removal, lead hole cleaning, and a variety of other jobs. Its compact size (less than 5" minus drill bit) allows use of the drill in confined areas and within cabinetry. High impact plastic housing makes it lightweight, and an extra long 10' cord provides a wide working radius. An on/off switch provides both "intermittent-on" and "locked-on" positions for convenience.

Operating at approximately 9,000 rpm, the drill is supplied with a collet chuck, 3 collets, and 2 drill bits (#56 and #71). The no. 6275 kit features a 110 V transformer power source, while the no. 6280 kits features a 12 V cigarette lighter plug assembly for on-the-spot drilling capability. Burrs, abrasive wheels, or discs can be added to expand the drill's versatility to carve, shape, form, or rout on wood, plastic, leather, and a variety of materials. *Wahl Clipper Corporation, 2902 Locust Street, Sterling IL 61081.*

FIRST COAX TOGGLE SWITCH

TEE/AX, Inc. of Ft. Lauderdale, Florida, has announced (after nine years of development) the first complete line of coax switches with features not previously available in coax switching. The TEE/AX coaxial toggle switches are available in every series, from SPST to 6PDT. The erector set construction of the switches allows the user to stack a VHF, BNC, TNC, and SMC in one switch. By removing the top place or toggle, you can replace it with a variety of solenoids to allow using the TEE/AX as a relay. The coax switch is fully designed to survive in any environment (such as that in aircraft, where shock and vibration are a factor). The TEE/AX coaxial switches are 100% anti-shock proof.

TEE/AX, Inc., will also fabricate coaxing switching systems and custom coax switches to specific customer needs. Over 300 variations of switches and relays will be available. Technical specifications are available on the entire coax switch line. *TEE/AX, Inc., 5701 NW 31st Ave., Fort Lauderdale FL 33309.*

The ISO-TIP electronic technician drill.

The TEE/AX coax toggle switch.

COMPUTERIZED MORSE CODE RECEPTION PACKAGE

Polaris Computer Systems has announced the development of a Morse code reception package for the S-100-based 8080 microcomputer. The package consists of a tone-to-dc converter module and complete software. The converter connects to the communications receiver via headphone jacks and to the computer via a parallel I/O port.

The converter contains a phase locked loop for tone decoding, and adjustable center frequency and bandwidth controls. Its design is highly immune to impulse noise. Provision for audio and visual synchronization of the incoming signal is provided.

The software adjusts for variations in transmission as each code element is received, allowing for manual or automatic transmission of CW at speeds ranging from 5 to 60 words per minute. Noise and dropout negating logic is included. The final output of received text is to an SIO port for display to a printer or CRT.

The package price in kit form for the converter, object program, and complete documentation is $95.00. An assembled and tested version lists at $145.00. Source tapes and complete turnkey packages are also available. On the low end, schematic of the converter, object dump, and documentation are available for $17.00. *Polaris Computer Systems, 3311 Richmond Avenue, Houston TX 77098.*

HEATH ANNOUNCES PERSONAL COMPUTERS

The latest entry into the hobby computer field is Heath, the popular manufacturer of electronic kits. The long-awaited computer product line consists of two processors, a video terminal, and an array of peripheral I/O devices.

Heath chose the widely available 8080 8-bit microprocessor as the basis for the H8 computer. The other computer, dubbed the H11, is based on the Digital Equipment Corporation (DEC) LSI-11 computer, which is a 16-bit minicomputer.

Targeted for release this summer, the H8 computer features an intelligent front panel with octal display and data entry capability. One-button program loading is provided by a resident monitor and built-in bootstrap program. Sixteen push-buttons are provided for data entry, and an LED display allows machine states and register contents to be displayed. A speaker is built into the H8 to allow special programming effects.

The H8 computer features a 1K ROM that contains the monitor program and bootstrap. The machine has a memory capacity of 65K bytes. The mainframe utilizes 50 pin connectors, of which 10 are available for memory and peripheral controllers. The built-in power supply can support the CPU, 32K of memory, and two I/O devices. The price for the basic H8 computer kit is $375.

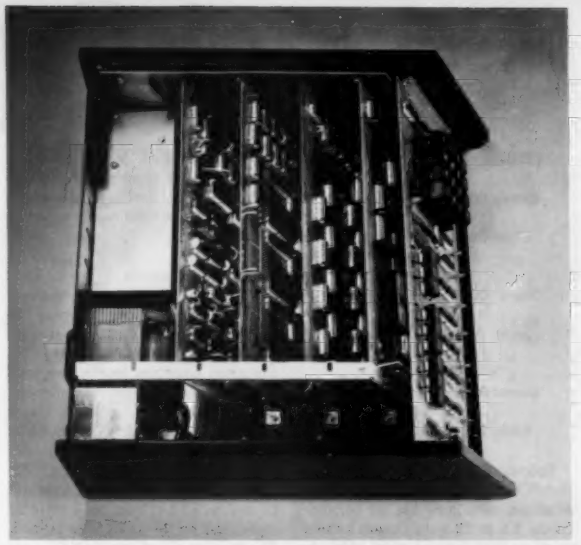
Heath has bridged the 8-bit gap with the H11 computer, to be shipped this fall. Based on DEC's powerful LSI-11 computer board, the H11 is a full 16-bit machine that features the DEC PDP-11 instruction set. The H11's CPU board is fully wired and tested. The LSI-11 board features 4K x 16 RAM, expandable to 20K. A switching power supply is standard, as is full circuit protection and a wired backplane. Interfaces initially consist of serial and parallel I/O modules. A 4K memory board is also available.

However, one of the most attractive features of the H11 is the software provided by Digital Equipment Corp. An assembler, editor, linker, and debug package is provided, as well as the BASIC and FOCAL languages. Owners of the H11 will also be able to use programs from the extensive DEC users group, DECUS.

A complete line of peripheral devices is available to support the H8 and H11 computers. A CRT display and paper tape reader/punch, designated the H9 and H10 respectively, will allow I/O capability. The following products will be available from Heath when H8 and H11 production commences:

H8	8080 Computer	$375
H8-1	4K Memory	140
H8-2	Parallel Interface	150
H8-3	4K Chip Set	95
H8-5	Serial/Cassette Interface	110
H9	Video Terminal	530
H10	Paper Tape Device	350
H11	LSI-11 Computer	1295
H11-1	4K memory	275
H11-2	Parallel Interface	95
H11-5	Serial Interface	95

The listed equipment is in kit form from *Heath Company, Benton Harbor MI 49022.*



Inside the H8: Heavy-duty power supply is visible, as well as the ten slot mother board.

Heathkit H11 Computer, based upon the DEC LSI-11.

The Heath 8-bit family: H9 Video Display, H8 Computer, and H10 Paper Tape Reader/Punch.

CONTESTS

Editor:
Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

EUROPEAN DX CONTEST
CW
Starts: 0000 GMT, Saturday, Aug. 13
Ends: 2400 GMT, Sunday, Aug. 14
Phone
Starts: 0000 GMT, Saturday, Sept. 10
Ends: 2400 GMT, Sunday, Sept. 11
RTTY
Starts: 0000 GMT, Saturday, Nov. 12
Ends: 2400 GMT, Sunday, Nov. 13

Sponsored by the Deutscher ARC (DARC), this contest is open to all amateurs, who may use all amateur bands, 3.5 to 28 MHz. Classes include single op/all band and multi-op/single transmitter. Only 36 hours of operation out of the 48 hours are permitted for single op stations. The 12 hours of non-operation may be taken in not more than three periods anytime during the contest. Each station may be worked once per band. A contest QSO can only be established between a non-European and a European station, except in the RTTY section, where contacts between all continents and one's own continent are permitted.

EXCHANGE:

An exchange consists of the usual 5 or 6 digit serial number, RS(T) report, plus progressive QSO number starting with 001.

SCORING:

Each QSO counts 1 point. Each confirmed QTC (given or received) counts 1 point (see below). The multiplier for non-European stations is determined by the number of European countries worked on each band. Europeans will use the last ARRL countries list. In addition, each call area in the following countries will be considered a multiplier: JA, PY, VE, VO, VK, W/K, ZL, ZS, UA9Ø. The multiplier on 3.5 MHz will be multiplied by four, on 7 MHz by three, and on 14 to 28 MHz by two. The final score is the total QSO points plus QTC points multiplied by the sum total multipliers from all bands.

QTC TRAFFIC:

Additional point credit can be realized by making use of the QTC traffic feature. A QTC is a report of a confirmed QSO that has taken place earlier in the contest and later been sent back to a European station. It can only be sent from a non-European station to a European station. The general idea is that after a number of European stations have been worked, a list of these stations can be reported back during a QSO with another station. An additional one point credit can be claimed for each station reported. For RTTY section only, QTC traffic is allowed between all stations (sent and received), but not between stations in the same country. A QTC contains the time, call and QSO number of the station being reported. Example: 1300/DA1AA/134. This means that at 1300 GMT you worked DA1AA and received number 134. A QSO can be reported only once, and not back to the originating station. Only a maximum of 10 QTCs to a station is permitted. You may work the same station several times to complete this quota, but only the original contact, however, has a QSO point value. Keep a uniform list of QTCs sent. QTC3/7 indicates that this is the 3rd series of QTCs sent and that 7 QSOs are reported. Europeans may keep the list of received QTCs on a separate sheet, if they clearly indicate the station which sent the QTCs.

ENTRIES AND AWARDS:

Certificates to highest scorer in each class in each country, reasonable score provided. Continental leaders will be honored. Certificates also given to stations with at least half the score of the continental leader. Violation of the rules, unsportsmanlike conduct, or taking credit for excessive duplicate contacts will be deemed sufficient cause for disqualification. The decisions of the contest committee are final. It is suggested to use the log sheets of the DARC or equivalent. Send a large size SASE to get the desired number of log and summary sheets (40 QSOs or QTCs per sheet). Mailing deadlines are: CW Sept. 15th; Phone Oct. 15th; RTTY Dec. 1st. Entries should be addressed to: WAEDC – Committee, Post Box 262, D-895 Kaufbeuren, Germany. North American residents may send their entries to: Hartwin E. Weiss WA3KWD, 323 North Street, Millersburg PA 17061 USA. Minimal requirements for a certificate or trophy are 100 QSOs or 10,000 points. European country list is same as shown for EURD awards!

Special note – Please keep the following sections free of contest activity. CW: 3550-3800, 14075-14350, 21100-21450, 28100-29700. Phone: 3650-3750, 14300-14350, 21400-21450, 28700-29700.

CAN-AM CHAMPIONSHIP CONTEST
Phone
Starts: 0200 GMT, Aug. 20
Ends: 2400 GMT, Aug. 20
CW
Starts: 0400 GMT, Aug. 21
Ends: 0200 GMT, Aug. 22

OBJECTIVE:

To increase the communication and friendship between the Canadian and American amateurs and to provide the means of measuring the performance of their operating skills and equipment.

BANDS:

All bands 1.8 through 28 MHz are permitted; general portion of the bands is recommended for use on phone and CW.

CATEGORY OF COMPETITION:

1. Single operator – stations operated by the station license holder.
2. Multi-operator, single transmitter – stations operated by one or more operators other than the licensee.
3. Club competition.

EXCHANGE:

Signal report, RS on phone and RST on CW, plus sequential QSO number starting with 001, plus multiplier area abbreviation, i.e., 59001CT or 599001ON. Multiplier area abbreviation is the usual two letter postal abbreviation for 50 US states, CN – Caribbean (KC4, KG4, KP4, KS4, KV4, KZ5), PC – Pacific (rest of US possessions). Canadians will use: NL – V01, V02; NB – VE1 New Brunswick; NS – Nova Scotia; PE – Prince Edward Isl.; SI – Sable and St. Paul Isl.; PQ – VE2; ON – VE3; MB – VE4; SK – VE5; AT – VE6; BC – VE7; NW – VE8 NWT; YU – Yukon.

MULTIPLIERS:

50 US states, 2 US possessions (Caribbean, Pacific); 10 Canandian provinces, 2 territories (NWT, Yukon), 1 Islands (Sable, St. Paul).

Total of 65 multipliers per band; maximum possible on all bands is 390.

POINTS:

1. Americans to Americans, Canadians to Canadians QSOs count for 2 points.
2. Americans to Canadians and vice versa QSOs count for 3 points.

The same station can be contacted once on each band and mode. Stations operating from outside of their own call area must sign slash and the area they are operating from, i.e., W6AM/7, W2PV/KH6, KP4AST/W2.

SCORING:

The final score is the result of the total QSO points from all bands, multiplied by the sum of the multipliers from all bands. Phone and CW sections of the contest are considered separate contests. However, combined scores of phone and CW will be used for overall competition. Combined scores will be calculated as a result of the addition of phone and CW scores.

AWARDS:

First place certificates will be awarded in each multiplier area on both modes in single operator category. Top five multi-operator stations will receive certificates. (Combined phone and CW scores will be considered.) Free one year subscription to *LONG SKIP* – The CANADX bulletin

CALENDAR

Aug 6-7	Illinois QSO Party
Aug 13-14	European DX Contest – CW
Aug 20-21	Worldwide SARTG RTTY Contest
Aug 20-21	SEANET Contest
Aug 20-22	New Jersey QSO Party
Aug 20-22	CAN-AM Championship Contest
Aug 27-28	Ohio Interstate QSO Party
Aug 27-28	Rep. of Trinidad and Tobago QSO Party
Aug 27-28	All Asian Contest – CW
Sept 3-5	Four Land QSO Party
Sept 10-11	Washington State QSO Party
Sept 10-11	Pennsylvania QSO Party
Sept 10-11	ARRL VHF QSO Party
Sept 10-11	European DX Contest – Phone
Sept 17-18	Scandinavian CW Contest
Sept 24-25	Delta QSO Party
Sept 24-25	Scandinavian Phone Contest
Oct 1	Open CD Party – CW
Oct 1-2	VK/ZL/Oceania – Phone
Oct 8-9	VK/ZL/Oceania –CW
Oct 15-16	Open CD Party – Phone
Oct 15-17	Manitoba QSO Party
Oct 29-30	CQ WW DX Phone Contest
Nov 5-6	ARRL Sweepstakes – CW
Nov 12-13	IPA Contest
Nov 12-13	European DX Contest – RTTY
Nov 13	OK DX Contest
Nov 19-20	ARRL Sweepstakes – Phone
Nov 19-20	WWDXA International CW Contest
Nov 19-20	All Austria Contest
Nov 26-27	CQ WW DX CW Contest
Dec 3-4	ARRL 160 Meter Contest
Dec 10-11	ARRL 10 Meter Contest

— will be awarded to the top 5 stations overall in both categories.

TROPHIES AND PLAQUES:

1. Single operator, overall — Canadian champion, American champion.
2. Single operator, phone — Canadian champion, American champion.
3. Single operator, CW — Canadian champion, American champion.
4. Multi-operator champion.

Each station is eligible for one trophy only. In a case where one station would qualify for another trophy, the less significant trophy goes to the next eligible station.

CLUB COMPETITION:

A handsome plaque will be awarded to the club submitting the highest aggregate score of the phone and CW scores submitted by its members under the same rules as CQ WW contest.

LOG INSTRUCTIONS:

All times must be kept in GMT. Indicate multiplier the first time only on each band. Log must be checked for duplicate contacts, correct QSO points, and multipliers. Do not use separate logs for each band. Each entry must be accompanied by a summary sheet showing all scoring information, category of competition, operator's name and callsign, address of the station, and signed declaration. Entries with over 200 contacts must include check sheets for each band. Official logs, check sheets, and summary sheets are available from CANADX — a large SASE will bring you samples.

DISQUALIFICATION:

Violation of amateur radio regulations in the country of the contestant or the rules of the contest, unsportsmanlike conduct, or taking credit for excessive duplicate contacts or unverifiable QSOs or multipliers will be deemed sufficient cause for disqualification. (Incorrectly logged calls will be counted as unverifiable contacts.) Actions and decisions of the CANADX contest committee are official and final.

DEADLINE:

All entries must be postmarked no later than September 30, 1977, and mailed to: Canadian DX Assn. — CC, Box 717, Station Q, Toronto, Ont. M4T 2N7, Canada.

NEW JERSEY QSO PARTY

Contest Periods:
2000 GMT, Saturday, Aug. 20 to 0700 GMT, Sunday, Aug. 21;
1300 GMT, Sunday, Aug. 21 to 0200 GMT, Monday, Aug. 22

The Englewood ARA invites all amateurs worldwide to take part in this year's annual contest. Phone and CW are considered the same contest. A station may be contacted once on each band and mode; CW contacts may not be made in phone band segments. NJ stations may work other NJ stations. General call is "CQ NJ". NJ stations are requested to identify themselves by signing "DE NJ". Stations planning active participation in NJ are requested to advise the EARA by August 6th of their intentions, so that full coverage from all counties can be planned. Portable and mobile operation is encouraged.

FREQUENCIES:

1810, 3535, 3905. 7035, 7135, 7235, 14035, 14280, 21100, 21355, 28100, 28600, 50-50.5, 144-146. Suggest phone activity on the even hours, 15 meters on the odd hours between 1500 and 2100 GMT, 160 meters at 0500 GMT.

EXCHANGE:

QSO number, RS(T), and QTH (NJ-county, others — ARRL section).

SCORING:

Non-NJ stations multiply number of completed QSOs times number of NJ counties worked (21 max.). NJ stations score 1 point per US/Canadian QSO, 3 points per DX QSO, and multiply total QSO points times number of ARRL sections (including NNJ and SNJ). KP4, KH6, KL7, KZ5, etc., count as 3 point DX contacts and as section multipliers.

ENTRIES AND AWARDS:

Certificates to first place NJ station in each county, and first place in each ARRL section and country. Second place certificates when four or more logs are received. Novice and Tech certificates also to be given. Logs must show date/time in GMT, band, emission, etc., and be received not later than Sept. 17th. The first contact for each claimed multiplier must be indicated and numbered, and a checklist of contacts and multipliers should be included. Multi-op stations should be noted and all calls listed. Logs and comments should be sent to: Englewood ARA, 303 Tenafly Road, Englewood NJ 07631.

REPUBLIC OF TRINIDAD AND TOBAGO QSO PARTY

Starts: 0000 GMT, Saturday, Aug. 27
Ends: 2400 GMT, Sunday, Aug. 28

This QSO party was organized by the Trinidad and Tobago ARSoc to commemorate the first anniversary of the Republic of Trinidad and Tobago. Use any band/mode, 10 through 160 meters, and OSCAR/SSB.

EXCHANGE:

Usual 5 and 6 digit exchange consisting of the RS(T) and serial number starting from 001.

AWARDS:

A certificate will be awarded to any station working 5 or more 9Y4 stations. Contacts may be on different bands, but must be in the same mode! A certificate with endorsement sticker and QSL cards confirming contacts will be awarded to stations working 9Y4 on five bands, all contacts in the same mode.

ENTRIES:

Logs should show date/time in GMT, stations worked, number sent/received. Logs only required for five station awards; QSLs required along with log for five band award. Include a remittance of $1.00 or IRC equivalent with logs if eligible for an award. Entries must be postmarked no later than Oct. 15th to: TTARS, PO Box 1167, Port of Spain, Trinidad, West Indies.

RESULTS

RESULTS OF THE 1977 DX YL TO NORTH AMERICAN YL CONTEST

DX Phone:		DX CW:	
DJØEK	714 points	I3MQ	143
DJ1TE	552.50	DJØEK	70
F5RC	488.75	DF2SL	9
NA Phone:		**NA CW:**	
W2GLB	1108 points	WA2DMK	11.25
VE3MRS	726	K6DLL	7.50
WA8EBS	432	W3CDQ	4
		W2HFR	4

Highest Combined Phone + CW:
DX = DKØEK, 784 pts.
NA = K6DLL, 337.5 pts.

RESULTS OF THE 1977 YL-OM CONTEST

YL Phone:		OM Phone:	
I3MWP	57,750 points	W4CHK	1,538
HB9ARC	26,934	W7ULC	805
FG7XL	25,125	WØGNX	648
YL CW:		**OM CW:**	
WA5VJW	17,010	W4CHK	1,463
K8ONV	13,484	W7ULC	1,295
K1NEI	10,710	VE3EMA	990

OHIO INTERSTATE QSO PARTY

Contest Periods:
1600 to 0200 GMT each day, Aug. 27 and 28

Co-sponsored by the Ohio Council of Amateur Radio Clubs and the Farout Amateur Radio Club of Kettering. This contest replaces the two contests originally planned by the two groups! Rules are as follows: Out of state stations work Ohio stations only; OH stations work any station. Each station may be worked once per band and mode. Multi-xmtr, multi-op stations are allowed, but are ineligible for awards. Repeater contacts are not allowed, except through OSCAR.

EXCHANGE:

Serial number, RS(T), and ARRL section or country — or OH county for OH stations.

SCORING:

Score 1 point per QSO. Add 50 points to final score for working Ohio State Fair Station NO8HIO. Multiply score by 1.5 for operating portable using temporary power and antennas in any OH county except Butler, Clark, Cuyahoga, Franklin, Hamilton, Lake, Lorain, Lucas, Mahoning, Montgomery, Portage, Richland, Stark, Summit, or Trumbull.

Note: The latest copy of the rules omitted the scoring multiplier, so I would assume that it would be the number of Ohio counties for non-Ohio stations and the number of ARRL sections for Ohio stations.

FREQUENCIES:

5 kHz up from lower edge of General class band.

ENTRIES/AWARDS:

Entries should include logs showing time, band, mode, and exchange info, summary sheet claiming score, and return mail address. Include an SASE for results. Logs must be postmarked by Sept. 15, and should be sent to: Joe WB8HWE, Box 7825, SR188, Circleville OH 43133. Trophies to highest OH and out of state. Certificates to top OH in each county and each ARRL section and DX score. Participation certificate to each entrant with 50 or more QSOs. Special certificate for working 3 or more Farout ARC members.

W8MBI

The Ohio Buckeye Belles will be operating their memorial station W8MBI (and individually) during the Ohio Interstate QSO Party, giving everyone an excellent opportunity to work Ohio YLs. The Buckeye Belles award a certificate to OH stations for 12 confirmed QSOs, to other US stations for 8 confirmed QSOs, and to DX stations for 4 confirmed QSOs. Send complete log data — name, call, date, time, band, mode, and Buckeye Belle numbers — to Certificate Custodian Marge K8ITF, 1608 Randeley Avenue, Dayton OH 45403. Please include 50¢ to help cover mailing costs.

EURD

Congratulations to Bruce Balla VE2QO, who was the first non-European station to obtain the RTTY Award EURD-3 from DARC. As of this writing, he is one of ten amateurs to receive this award — only three have made it to the top (EURD-1).

Dual Rhombic For VHF-UHF

-- work some DX!

Bill Parker W8DMR
2738 Floribunda Drive
Columbus OH 43209

What single antenna can provide 26 dB of gain over a half wave dipole and also

(a) exhibit relatively low wind resistance;
(b) operate over a bandwidth approaching twice the design frequency;
(c) permit shared mast mounting with other antennas for ease of rotation;
(d) is easy and not overly time-consuming to construct; and
(e) is light of weight and inexpensive (under $20) too?

A parabolic dish cannot. The optimum spaced long yagi cannot. A collinear array cannot. Nor can the log periodic, corner reflector, helix, or any other antenna. The dual rhomboid *can!*

The need for high antenna gain still exists. High gain antennas (in excess of 20 dB) are very directional antennas providing beamwidths between 5 and 10 degrees. Antenna gains greater than 30 dB produce half power beamwidths of less than 5 degrees and require very accurate pointing systems. Antennas with gain exceeding 20 dB are used on VHF, UHF, and higher. For best results at these frequencies, the antenna must be placed high and above the surrounding obstructions. Wind loading produced by such mast-mounted rotatable antennas at the top of the tower cannot be ignored if the antenna system is to survive.

Can you imagine a 21 foot diameter parabolic dish antenna[1] (required to produce 26 dB of gain) mast-mounted and rotatable on a 50 foot tower in a 50 mph wind? Even with the reflector constructed of 1 inch wire mesh? Over 750,000 foot-pounds of torque will be generated at the base of the tower. And that is without any additional antennas or any additional mast height. The dish antenna (excluding satellite work) to be effective requires a structure and platform to support it. Construction of the dish antenna is not the easiest of tasks.

The long yagi certainly has less wind resistance. An optimum spaced long yagi[2] requires a 100 foot boom to yield 26 dB of gain. It is easier to construct and could be made light in weight. But the 1 to 1.5 percent bandwidth of the operating frequency limits the usefulness, especially on the 420-450 MHz band. Stacking two 50 foot boom long yagis could be done with some ease. The stacking distance will require a mast extending out of the top of the tower in excess of 25 feet if the equivalent 26 dB of gain is to be realized. The torque loads created in starting and stopping a 100 foot boom represent an additional problem for the rotator mechanism. The swaying of a high gain long yagi antenna during gusty wind produces signal variations during both transmit and receive (similar to QSB created by atmospheric changes along the signal path).

Consider a 26 dB gain collinear array antenna. The array would have a lot less wind resistance than the dish antenna. It would also exhibit more bandwidth than the yagi. It would require, however, an array of 12 elements broadside (high) by 8 elements collinear (wide). It would take a total of 96 driven elements plus 96 reflector elements[3] to provide a gain of approximately 23 dB. To obtain the additional 3 dB for a 26 dB gain collinear array, the total array needed would contain 384 elements and a frame to support them. Even at 435 MHz, more than 384 feet of element material would be required. If the 192 reflectors were replaced with a screen mesh, more than 300 square feet would be required. Although a substantial improvement in bandwidth would be realized, a considerable increase in wind loading occurs.

The dual rhomboid antenna provides a gain of 26 dB

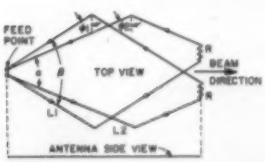


Fig. 1. Dual rhomboid antenna configuration.

(an effective radiated power increase of 400 times). It has relatively low wind resistance, wide operating bandwidth, consumes little mast height, is light of weight, easy and inexpensive to construct, and is rotatable.

The dual rhomboid is of the rhombic class, but with improvements. The double rhomboid antenna[4] configuration is shown in Fig. 1. Longwire antennas always radiate large numbers of side lobes that are distributed profusely. Judicious choice of the side length and apex angle selection of the rhomboids can cause destructive interference of the unwanted and wasteful side lobes. The dual rhomboid antenna designed for a high order of side lobe suppression at one frequency retains this characteristic very well over a substantial frequency range. This is not possible with a single rhombus.

The design principles involved are the same as for the "V" antenna and the rhombus antennas. The angles (referred to as tilt angles) were expressly selected for zero angle radiation from each rhomboid[5]. Since most antennas of the rhombus class operate against ground (heights of less than one to two wavelengths), zero angle radiation tilt angles are not normally selected. See Figs. 2 and 3.

The length of sides L_1 and L_2 specifically differ by a one-half wavelength factor. The array radiation pattern is the *product* of the patterns for the component sides at all points in space.

The only connection between the rhomboids is at the common feedpoints. The antenna consists of two rhomboid elements connected in parallel at their common apex where a balanced feedline connects[6]. One terminating resistor is required for each rhomboid. The terminating resistors should be of the noninductive variety and able to withstand the weather. Each terminating resistor should be capable at least of dissipating one-fourth of the input power to the antenna. Termination values of between 600 and 800 Ohms are recommended. For example, if 10 Watts is applied at the feedpoint, each resistor should be capable of 2.5 Watts dissipation.

The list of parameters for the dual rhomboid antenna shown in Table 1 is for a design frequency of 435 MHz.

The side lengths are calculated from the following formula:

$$L \text{ (feet)} = \frac{984\ (N - 0.05)}{\text{Freq. (MHz)}}$$

where N is the number of full waves. L_1 and L_2 for a design frequency of 435 MHz are 93.5 and 161.5 inches, respectively. The side lengths are needed to determine the boom length and the three crossarm lengths.

Apex angles α and β are derived by:

$$\alpha = 2(90 - \phi_2)$$
$$\beta = 2(90 - \phi_1)$$

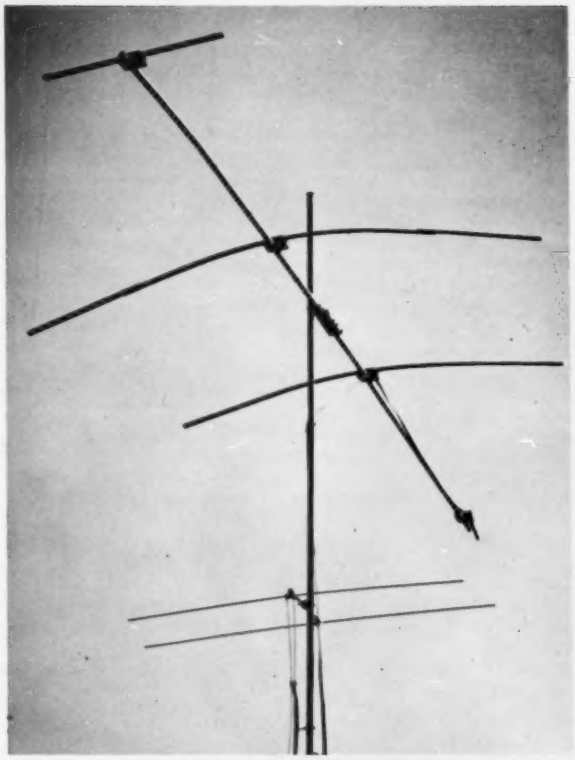
and are 46 and 58 degrees, respectively. The tilt angles ϕ_1 and ϕ_2 were selected for side lengths of 3.5 and 6.0 wavelengths, as well as zero angles radiation.

The dimensions for boom, crossarms, and crossarm spacing are shown in Fig. 4.

Design Center Frequency		435 MHz
Side length #	$L_1 = 3.5\lambda$	$L_2 = 6.0\lambda$
Tilt Angle	$\phi_1 = 61^\circ$	$\phi_2 = 67^\circ$
Apex Angle	$\alpha = 46^\circ$	$\beta = 58^\circ$
Beam Width *	V = 5.8°	H = 9.7°
Termination	R = 820 Ohms	R = 820 Ohms

*Half power level
#L_1 = 7.8 feet, L_2 = 13.46 feet

Table 1. List of parameters for dual rhomboid.



Dual rhomboid antenna installation at WA8QQU, Reynoldsburg, Ohio.

The angle subtended between the diagonal of each rhomboid is equal to:

$$\frac{\beta - \alpha}{2} = \frac{58 - 46}{2} =$$

6 degrees

An isosceles triangle is formed at the forward end of the beam by the rhomboids' crossover and the two terminators. Detailed specific dimensions for construction of the high gain dual rhomboid antenna whose bandwidth is essentially 420 to 890 MHz are shown in Fig. 4.

Construction

A metal boom that runs the full length of the dual rhomboid is not recommended. Excessive side lobes will be generated if this construction technique is em-

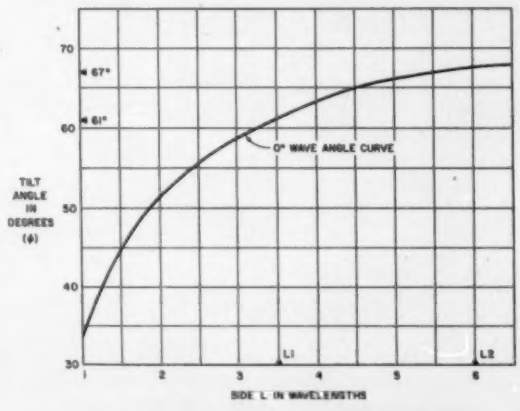


Fig. 2. Zero degree wave angle design chart.

Dual rhomboid antenna held with one hand by W8DMR's XYL. Total boom length is 20'6".

ployed. The center section of the boom should be made of metal or of material sufficiently rigid to support the nonmetallic crossarms. A total of about 86 feet of wire is required with each leg of the rhomboid being about 21½ feet long. The conductor size should be as large as the antenna frame can adequately support. Number 14 AWG solid copper, formvar coated was used in the author's dual rhomboid antenna. Even ¼ inch tubing is recommended. Although not recommended, a model used #24 AWG enameled single strand copper with some success.

The transmission line from the feedpoint to the mast should be foam 300 Ohm balanced nonshielded line. Open wire line or foam line works well. Once the feedline reaches the mast, a change to shielded 300 line or coaxial cable can be made. In the case of coaxial cable, a broad band balun should be used. If nonshielded 300 Ohm line is used, ABSOLUTELY DO NOT TAPE the feedline to any metal structure. This includes the metal section of the boom, the mast, the tower, other coaxial cables, downspouts, gutters, metal house siding, or metal sash windows. Never permit nonshielded 300 Ohm line to run along the ground or against masonry walls and floors, even if it is foam filled.

Operational Tests

The antenna has been used primarily to receive and transmit standard scan amateur TV signals. A secondary use has been to receive UHF commercial TV channels 14 through 83. The antenna has been used to receive channels 2 through 13, with less gain. The results have been excellent, with the exception that lobing was experienced on the higher UHF TV channels. The antenna has good front to back ratio. The antenna was rotated to vertical polarization to verify that the angle of radiation was truly zero. The antenna did not have a double (split) lobe in the vertical axis.

Additional Improvement

The dual rhomboid can be expanded such that it could be referred to as the quad rhomboid. This would be accomplished by adding two additional rhomboids, as in Fig. 5. There would be still a single feedpoint, but two additional terminators would

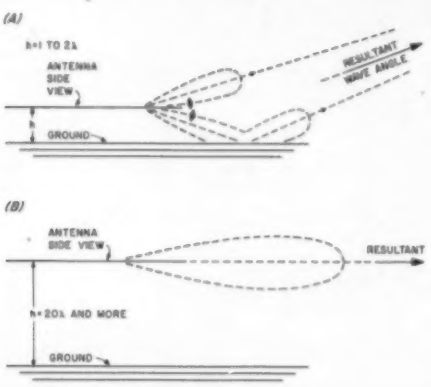


Fig. 3. Effect of tilt angle selection. (a) Non-zero angle radiation, rhombic antenna working against ground. (b) Zero angle radiation due to tilt angle selection. Note: *Tilt angle does not mean physically tilt the antenna. See Table 1.*

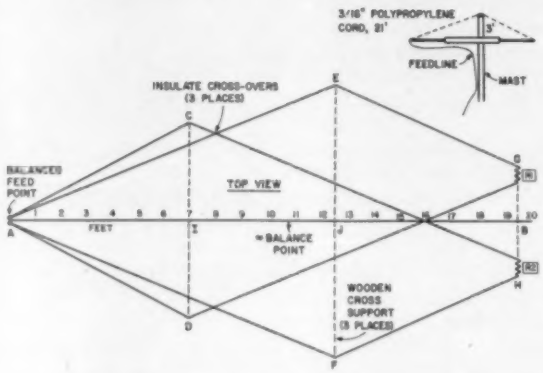


Fig. 4. Dual rhomboid antenna for 435-870 MHz. Beamwidth ≈ 10° H x 6° V. Gain over DP ≈ 26 dB. Boom length: AB = 19'6". Support spacing (see text): AI = 7'; IJ = 5'6"; JB = 7'. Support length: CD = 7'3"; EF = 10'3"; GH = 3'0". Rhomboid sides: AC, AD, EG, FH = 7'9.5"; AE, AF, CH, DG = 13'5.5". Feedline: see text. Wire needed: 14 AWG formvar, ≈ 86'0". Boom material: AI, JB = wood; IJ = metal. Cross support: CD, EF, GH = wood. Terminators: R1, R2 = 600 Ohms; Watts – see text.

be required. The feedpoint impedance would be lowered. The additional rhomboids should have different side lengths; as an example, L_3 could be 2.5 wavelengths and L_4 could be 7.0 wavelengths. The quad rhomboid would not require any additional mast space, as would be the case in stacking an additional dual rhomboid.

Acknowledgment

The contribution of Bob Dervin WA8QQU in field tests and experimental models is gratefully acknowledged. ■

References

[1] Parabolic Antenna Calculators, Gabriel Electronics Division, Needham Heights MA, 1959.

[2] "Yagi array length versus gain and bandwidth," *VHF Handbook*, 1956, page 104.

[3] "Collinear-broadside antenna combinations," *VHF Handbook*, 1956, page 105.

[4] "Improved Antennas of the Rhomboid Class," *RCA Review*, 1960, pages 117-119, Laport and Veldhuis.

[5] "Rhombic antenna design chart," *The ARRL Antenna Book*, 1956, page 168, 178.

[6] "VHF Rhombic Antennas," *Antenna Engineering Handbook*, N. Jasik, Editor, 1961, pages 4-30 to 4-33.

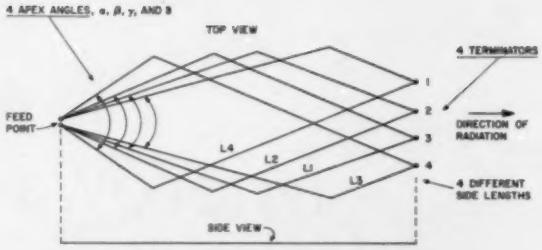


Fig. 5. Quad rhomboid antenna configuration.

Corrections

Just a note to let you know that in the June *73* issue, on page 176 ("Current-Saver Counter Display," Fig. 4), there is an error in the circuit. The outputs of the two 7400 chips should be bussed before driving the 7447 decoder-driver. The existing schematic is incorrect in that the outputs of the "Latch No. 1" 7400 do not drive the decoder.

Doug Marquardt WB2AWG
Bogota NJ

The article, "Aim Your Antenna With a Micro," in the June, 1977, issue of *73*, contains an unfortunate typographical error (of omission) and leaves implicit that which needs to be made explicit for some of us who not only cannot read "between the lines" but are having real difficulty with the lines themselves!

First, the omission. FORTRAN statement 290 correctly contains the minus sign (PL1 = -87.63*PIE/180) before the longitude. The corresponding BASIC statement number 170 omits this necessary minus sign.

Second, the implicit information which should have been quite explicit: The authors imply in the description of the FORTRAN program that the program contains the constants which represent the local latitude and longitude, as indeed it does. However, clarity of expression seems to dictate an *explicit* sentence or sentences such as the following:

> "It should be noted that FORTRAN statements 260 and 290 contain the latitude and longitude, respectively, of Chicago, as do the corresponding BASIC statements 140 and 170. For other 'local' locations, change 41.87 and -87.63 to the proper latitude and longitude."

A couple of sentences such as the above would have been most helpful, but then I would have been deprived of a little troubleshooting and the feeling of euphoria which I experienced when I finally found out where the "bugs" were. Other than the problems above, the article was excellent and now I can swing my hybrid-quad with arrogant precision. Those who are familiar with that miniaturized rf choke of an antenna may well ask, "Why bother?" Because it provides valuable practice and experience for the time when I will finally have an antenna with a decent front-to-back ratio and appreciable gain, that's why. So don't bother me while I aim my two element mini-antenna right down that Zed-El's throat. Who knows, maybe someday he'll come back to me and I can casually give him his correct beam bearing to several decimal places!

Ronald W. Evans K5MVR
Fort Worth TX

Please note a correction to my article, "Two Meter Scanner" (June, 1977):

The power input driving the LEDs through a 430 Ohm resistor is incorrectly marked "+5 V." This point should be marked "+12 V," as the display will not function correctly with a five volt supply.

Carl A. Kollar K3JML
Nanticoke PA

In my article, "Sending HI on the Hooter," in the May, 1977, issue of *73*, a few things were overlooked. The relays, RY1 and RY2, do have some limitations on their choice. RY1 is driven by a TTL output and should pull in at 5 volts and 16 mA maximum. RY2 should pull in at 5 volts and 80 mA maximum and also have a contact capable of switching ½ Amp of inductive load.

James F. Reid W8LWS
Ashley OH

I feel that your magazine is the tops. I really enjoyed the article "Superprobe," but found one error. The pulse LED would stay on all the time. Resistor R9 is drawn on the wrong place on the schematic; it should go from pin 4 of IC2 to ground, not from pin 3 of IC2 to ground. R1 can be increased to about 5-10k to increase input impedance.

Allan Armstrong
San Francisco CA

Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit	Date (Aug)	Time (GMT)	Longitude of Eq. Crossing °W		Orbit	Date (Aug)	Time (GMT)	Longitude of Eq. Crossing °W
N 21919	1	0154:13	90.9		12394 A	1	0008:53	56.1
NA 21931 BTN	2	0054:09	75.9		12407 B	2	0103:10	69.7
NA 21944 BTN	3	0149:04	89.7		12419 AX	3	0002:31	54.5
N 21956	4	0049:00	74.7		12432 B	4	0056:48	68.1
NA 21969 BTN	5	0143:56	88.4		12445 A	5	0151:05	81.7
N 21981	6	0043:52	73.5		12457 B	6	0050:26	66.5
NA 21994 BTN	7	0138:48	87.2		12470 A	7	0144:43	80.1
N 22006	8	0038:44	72.2		12482 BQ	8	0044:04	65.0
NA 22019 BTN	9	0133:39	86.0		12495 A	9	0138:21	78.6
NA 22031 BTN	10	0033:35	71.0		12507 BX	10	0037:41	63.4
N 22044	11	0128:31	84.7		12520 A	11	0131:59	77.0
NA 22056 BTN	12	0028:27	69.7		12532 B	12	0031:19	61.8
N 22069	13	0123:23	83.5		12545 A	13	0125:36	75.4
NA 22081 BTN	14	0023:19	68.5		12577 B	14	0024:57	60.3
* 22094 L	15	0118:14	82.2		12570 BL	15	0119:14	73.8
* 22106 L	16	0018:10	67.2		12582 BL	16	0018:34	58.7
* 22119 L	17	0113:06	81.0		12595 BL	17	0112:52	72.3
N 22131	18	0013:02	66.0		12607 B	18	0012:12	57.1
NA 22144 BTN	19	0107:57	79.7		12620 A	19	0106:29	70.7
N 22156	20	0007:53	64.7		12632 B	20	0005:50	55.5
NA 22169 BTN	21	0102:49	78.5		12645 A	21	0100:07	69.1
N 22181	22	0002:45	63.5		12658 BQ	22	0154:24	82.7
NA 22194 BTN	23	0057:41	77.2		12670 A	23	0053:45	67.5
NA 22207 BTN	24	0152:36	91.0		12683 BX	24	0148:02	81.1
N 22219	25	0052:32	76.0		12695 A	25	0047:23	66.0
NA 22232 BTN	26	0147:28	89.7		12708 B	26	0141:40	79.6
N 22244	27	0047:24	74.7		12720 A	27	0041:00	64.4
NA 22257 BTN	28	0142:19	88.5		12733 B	28	0135:18	78.0
N 22269	29	0042:15	73.5		12745 A	29	0034:38	62.8
NA 22282 BTN	30	0137:11	87.3		12758 B	30	0128:55	76.4
NA 22294 BTN	31	0037:07	72.3		12770 AX	31	0028:16	61.3

The listed data tells you the time and place OSCAR crosses the equator in an ascending orbit for the first time each day. To calculate successive orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the first crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world, it will descend over you. To find the equatorial descending longitude, subtract 166 degrees from the ascending longitude. To find the time it passes the north pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR when it is within 45 degrees of you. The easiest way to do this is to take a globe and draw a circle with a radius of 2480 miles (4000 kilometers) from the home QTH. If it passes right overhead, you should be able to hear it for about 24 minutes total. OSCAR will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15 degrees from you, add another minute; at 30 degrees, three minutes; at 45 degrees, ten minutes.

OSCAR 6: Input 145.85-145.95 MHz; Output 145.90-146.00 MHz; Output 29.40-29.50 MHz. OSCAR 7 Mode A: Input 29.45-29.55 MHz; Telemetry beacon at 29.45 MHz. Mode B: Input 432.125-432.175 MHz; Output 145.925-145.975 MHz.

Orbits designated "X" are closed to general use. "ED" are for educational use. "BTN" orbits contain news bulletins. "Q" orbits have a ten Watt erp limit. "L" indicates link orbit. "N" or "S" indicates that Oscar 6 is available *only* on northbound or southbound passes. Satellites are not available to users on "NA" days. An asterisk (*) indicates AO-7B-6 intersatellite link.

K. W. Moak
Northwood NH 03261

Microwave Waveguide Details

-- square copper tubing?

Waveguide plumbing is the designer's choice for microwave circuits operating from 2000 MHz upwards. It's generally available at surplus stores, and often quite cheaply, yet relatively few amateurs experiment with it because of its striking dissimilarities to conventional transmission line. Actually, waveguide techniques are not difficult to master, and a properly assembled system can open up a whole new radio spectrum to the experimenter.

There are a number of different types of waveguide, round, elliptical, and other shapes, but by far the most widely used is rectangular. This last is almost the only kind usually available to amateurs, so I will confine my remarks to it.

Waveguide can be described as a double wire transmission line with an infinite number of quarter wave insulators connected along it so as to form a closed tube. The means of wave propagation along it are, however, more complex than that in a two-wire line. It consists of both an electric and a magnetic field at right angles to each other which reflect from wall to wall along its length. Different modes of operation, that is, different orientations of these fields, allow more than one wave to travel through the same waveguide at the same time making it ideal for multiplexing. Circuit elements are provided by changing the properties of the inside of the tube, by altering the dimensions, by inserting obstacles into the path of the waves, by manipulating reflections, or by making cavities for the waves to resonate in. The key fact is that with waveguide it is the space inside that carries and controls the waves, rather than wires and solid components.

All waveguide components are complete units designed to be bolted into a system. This is a great advantage at microwave frequencies where the very critical measurements involved would make construction and fitting of parts a difficult task. A waveguide system is assembled more or less in the same way as an ordinary plumbing system with the notable difference that even the plain lengths of pipe are preformed so that no cutting or other machining is necessary. There are a large number of different components available, both fixed and adjustable, in a variety of sizes, corresponding to different bands of operation. All components in a system should, of course, be for the same band, so take care to measure the dimensions when buying.

The band of operation for any given size of rectangular waveguide can be determined easily from two simple formulas. The orientation of the waves at the optimum frequency is known as the dominant mode and is generally utilized. Operation outside of the dominant mode is inefficient and usually undesirable.

To find the dominant mode, divide the longer inside dimension (in inches) into 7,376, which gives the minimum desirable frequency in MHz, and then divide the same dimension into 11,136, which will give the maximum. These two frequencies span the most efficient band of operation. However, they do not represent cutoff frequencies, so there is a certain amount of leeway possible to the designer.

Energy is coupled into or out of waveguide by short probes, diodes, horns, or openings in the waveguide walls. Many microwave oscillators incorporate a section of waveguide with a probe, so they may be connected directly into a system. Others may have to be coupled by short lengths of coax. For transmitting, the system often terminates in a dipole antenna (usually backed by a reflector, the familiar radar dish) or a simple horn which serves as an impedance match to the open air. Sometimes a horn may feed into a reflector as would a dipole, and there are still other methods used, including horn arrays that act like lenses. Given care and patience, suitable antennae and reflectors can often be fabricated by an experimenter.

Waveguide sections are joined in one of two ways, either by flat, precisely matched surfaces, or by grooved, recessed "choke" flanges. The latter, although less efficient, is often used since it enables sections to be joined without extremely fine machining of their mating surfaces, thus lowering cost and improving interchangeability. There are often O-rings or thin metal gaskets between flanges to improve both the electrical and mechanical connections. With the choke connector it should be noted that only one of the mating surfaces is provided with a groove, the other being flat.

Quick-disconnect choke couplings are available, designed for use in situations where one system might have to be alternately coupled to several others, as in test equipment, for instance.

In commercial and military applications the system is usually filled with a pressurized gas, often nitrogen, both for efficiency and reliability, but experimental installations can forego this. Just be sure to keep the inside of the waveguide clean and dry. Any dust or condensed moisture will cause arcing and power loss.

The most popular method of joining waveguide flanges seems to be with small hollow-head screws and nuts, but any suitably sized fasteners will probably do. While not necessary, some attempt at torquing the fasteners equally might result

in slightly less power loss.

I can only begin to describe a few of the many types of components available for waveguide systems, those which you would be likely to have use for in a simple setup. Movable metal slugs projecting into the waveguide are used as tuning stubs to eliminate undesirable reflections, or as filters. These are often installed just after the input or just before the output. Metal or conductive plastic plates or vanes, some adjustable, some fixed, serve as attenuators by effectively changing the dimensions of the guide, and wedges or blocks of graphite or metal in the end of a section act as terminating resistors.

By far the most important group of waveguide components is that which incorporates tunable cavities which act as resonant circuits at microwave frequencies. This group includes not only passive components, but also a large percentage of microwave oscillators and amplifiers which have built-in cavities. Some oscillators, notably the magnetron, are actually little more than resonant cavities in function. A cavity used as a discrete component will often be in the form of a relatively large cylinder with one end movable, so that the size can be changed. These units are, of course, as important in microwave systems as conventional resonant circuits are at lower frequencies.

The various waveguide components are interconnected by sections of plain waveguide, available in various lengths, straight, angled, or flexible. Some are so constructed that two or more inputs are mixed into one output, others so that a fractional part of the wave energy can be drawn off for measurement or other purposes. Mechanical switches are made to transfer a wave from one guide to another, and various electronic methods have been devised to provide transmit/receive switching. In short, waveguide can be used to implement the equivalent of almost any conventional circuit.

Often complete waveguide systems can be obtained in the form of radar test sets. Such a set might include a wide band oscillator with power supply, one or more tunable cavities, usually precisely calibrated, and an assortment of waveguide sections and components, attenuators, tuning stubs, coax outputs, and impedance matches. If you can find such a unit it makes an ideal beginning in waveguide which can be added to as you see fit.

This short article is no place to go into the complex field of microwave oscillators and amplifiers, nor that of measuring devices, nor the evergrowing number of solid state components used especially in very high frequency microwave systems. Many of the newer components are not generally available to the amateur anyway. Any good microwave handbook will provide a wealth of information on these more specialized fields. Most large city libraries will have at least one such handbook, which is also must reading for anyone interested in ordinary waveguide circuitry.

With microwaves being used more and more, now is the ideal time to learn the ins and outs of waveguide, before the surplus prices start skyrocketing. In no other branch of electronics does the behavior of waves so nearly approximate physical analogies. This makes waveguide an interesting and enlightening variation on familiar theory and technique. Even if you never plan to get on the air with microwaves you will find it worth a modest investment to experiment with this unique and fascinating branch of electronic technology. ■

LETTERS

from page 7

recently took the FCC General class exam on the 9th of May, here in St. Louis. I experienced no difficulty in passing the code portion of the exam; in fact, I found it very easy to copy the material given. Unfortunately, I failed the written portion of the test. I will be trying it again in June at the Kansas City office.

Again, your tape really helped more than any other tape I have used, and I highly recommend it to other would-be General class amateurs. I am seriously thinking about tackling your 20 wpm tape.

Patrick M. Brown WBØTTP
Hanley Hills MO

STEELY-EYED

I have been an avid reader of your publications for many a year now, and far prefer them over any of the other ham magazines. I very much appreciate your policy of accepting advertising from only the most reputable firms, and also enjoy your editorial views and opinions. I must, however, take issue with one of your own advertisements – the one for the *73* code tapes.

In your text you make mention of the fact that an extra word or two per minute in code speed is necessary due to nervousness when appearing before "the steely-eyed examiner" at the FCC. I have recently returned from the Baltimore field office, General class privileges in hand. I must state that all of the personnel in the Baltimore office are anything but "steely-eyed." From the young lady administering the receiving test, to the gentleman giving the sending test, to the Engineer-in-Charge – each was most polite, kind, and did his best to put me at ease. Each did his job in a manner designed to relax the applicant and contribute to success.

I wish you would change the text of your advertisement for your excellent tapes to state that despite the sincere efforts of the friendly examiners, an extra word or two per minute is necessary to combat inevitable nervousness on the part of the applicant. Thank you.

Mayer D. Zimmerman W3GXK
Randallstown MD

LIMARC CLASSES

The Sewanhaka Central High School District, in conjunction with the Long Island Mobile Amateur Radio Club, is sponsoring a course in amateur theory and code as part of the adult education program.

LIMARC is providing the instructors while the school district is providing the facilities. There will be *no* tuition or registration fees.

Classes will be held on Wednesday evenings at Elmont Memorial High School, Elmont, L.I.

Interested persons should contact the Adult Education Office at (516) 328-4875.

John F. Gillen WA2CWT
Public Information EMHS
555 Ridge Road
Elmont NY 11003

BACK TO BASICS

I enjoy *73*, but I would like to see more basic electronic tutorial articles (how do you bias transistors, design simple amplifiers, etc.) and save the I/O stuff for *Kilobaud* (which I also get and enjoy). I don't particularly object to the computer articles, but I am a self-taught professional systems programmer, and my electronics background (and my typing) isn't very solid. I can design and get to work digital circuits (just an extension of programming, sort of), but I am almost lost in analog areas. In any case, I approve of your efforts to make computer technology more understandable to the world at large.

Stan Webb
Albuquerque NM

Get the picture, authors? – J.M.

220–NO LOSS

As an active amateur, I am in favor of the loss of up to 1 MHz of our 220 MHz band to CB for the following reasons:

1. We amateurs would really lose nothing, as we could operate on the lost frequencies with our CB license.
2. It will reduce the price of 220 MHz radios, due to mass production for us.
3. CB really needs more room at a practical low cost frequency.

I have already written the ARRL of my proposal.

M. P. Lewton WA6PHR
Santa Maria CA

J. Tom Badgett K4MDK
1917 Washington St.
Bluefield WV 24701

Centerfed Specials

-- for the small city lot

I never believed in fancy antennas. I never read the articles on windoms and long wires and "apartment dweller" specials. Endfeds and directive arrays for the lower frequencies seemed frivolous folly. The only sensible antenna was a centerfed dipole, lovingly pruned to frequency. For years I swung these carefully constructed antennas free and clear, at a right angle to the shack, because that's what the books said to do.

Then I had to make an agonizing decision to compromise my principles or go off the air on 80 meters. I moved a proven centerfed antenna to my new house, but it wouldn't fit the lot. After days of pacing and measuring, I rationalized that it wouldn't hurt this successful dipole to -- say it softly -- *bend the ends just a little*. I kept telling everybody I was running a regular, run-of-the-mill 80 meter dipole, partly because I was ashamed to admit the sacrilege I'd committed, and partly because my transceiver loaded the same as always.

That first tentative transgression opened wide the door to further sin. It wasn't long before I was running drooped and twisted dipoles on several bands, and with the same good results. I reasoned these antennas succeeded because they were, after all, still the proven centerfed dipoles I had used for years even if they weren't erected by the book. Little did I know I was on the road to the ultimate sin.

In just over a year, I've moved twice and neither QTH allowed room for my comforting dipoles, no matter how I contorted them. In fact, in the first location space was so restricted (mainly because of a lease agreement) it was months before I skulled out an antenna design. In the interim, I spent the evenings hunched over an allband receiver I'd bought with proceeds from the sale of my transceiver. I strung a 20' length of wire around the room and became a shortwave listener.

A ham can listen only so long, though, so I borrowed an old Johnson Viking and hooked it right up to that same short wire. You know what? The damn thing loaded. I've got 579 reports on 40 meter CW from all over the country to prove it!

The little antenna worked so well I naturally began thinking of the companion transmitter for my state-of-the-art receiver. Before the new unit arrived, I decided to put up a real endfed antenna outdoors, a design I hadn't seriously considered before (perhaps necessity really is the mother of invention).

Now, I don't want to do anything to refuel the swr controversy -- honest. But I feel compelled to write about my conversion and what I've learned about practical antenna design because of it.

I read the antenna books, then bought some 300 Ohm balanced line and a 4:1 balun. I managed to get 250' of wire in the air and fed it at the end with 100' of the balanced line, attached the balun and ran coax on into the shack. I had no swr bridge or tuner, but I got a good solid dip and could load my transmitter on all bands with no RFI problems -- never mind that the books say this kind of antenna requires a matching device to function properly.

I was really corrupted by this point, so when I moved again I didn't hesitate even a day getting up an antenna. I didn't bother with the balanced line for this one. I stretched 100' of wire and endfed it with coax and the 4:1 balun. The shorter wire seems a little more sensitive to frequency change than the

Swr for Different Feedline Impedances

f	N	R	110 (Med.)	300	150	75	50
1.8	0.5	70	1.6	4.3	2.1	1.1	1.4
3.5	0.9	90	1.2	3.3	1.7	1.2	1.8
7	1.8	108	1.0	2.8	1.4	1.4	2.2
14	3.6	130	1.2	2.3	1.2	1.7	2.6
21	5.4	145	1.3	2.1	1.0	1.9	2.9
28	7.2	150	1.4	2.0	1.0	2.0	3.0

$$N = \frac{fL + 24.6}{984}$$

$$Swr = \frac{R}{Z} \text{ when Z is larger than R}$$

$$Swr = \frac{Z}{R} \text{ when R is larger than Z}$$

where f: Frequency in MHz
L: 250'
N: Number of wavelengths for antenna
R: Antenna radiation resistance (see text)
Z: Feedline impedance

Fig. 1. Swr for a 250' endfed antenna.

longer model, but I still get good loading and a solid dip on any frequency on all six high frequency ham bands. There's still no outboard tuner or swr bridge in the circuit.

I keep daily CW and phone schedules with a fellow ham in South Carolina, and we've been plotting signal strengths on 80 and 40 meters since we started the contacts about six months ago. Bill K4WGP reports that no noticeable change in signal strength occurred when I changed from the 250' antenna to the 100' model.

Now for the theory part of this discussion. If we can agree with Rayer ("Exploding the SWR Myth," *73*, Dec., '76) that as long as you get a good dip from your transmitter, a tuner won't change the amount of antenna current flowing in the line (or your signal at the other end), then we can discuss theoretical swr and make happy all those people who just won't fire up their rigs unless the swr is less than 2:1.

Swr is a factor of antenna and feedline impedance. Feedline impedance for ham purposes is easy to determine because we buy lines with published impedances for specific purposes. Antenna impedance is another matter. This figure depends on the radiation resistance, height above ground, proximity to nearby objects and conductor size. For most HF ham antennas, the practical impedance usually can be considered to be the radiation resistance. For a centerfed, half wave antenna, that figure is between 60 and 70 Ohms — perhaps higher or lower depending on influences which take the antenna away from the theoretical ideal.

The figures become somewhat more complicated when an allband design is considered. As the operating frequency is moved from resonance, antenna reactance begins influencing impedance. The change is a cyclic one and interestingly enough the rate of impedance change decreases as frequency increases, assuming the antenna length stays the same. I have found by practical experience that when using an endfed wire of sufficient length, its radiation resistance is a good enough impedance figure for ham purposes.

If we start with a half wave antenna fed at a current loop, at the end in this case, the radiation resistance is approximately 70 Ohms. If the operating frequency is increased or the antenna is made longer, the resistance also increases. A one wavelength antenna has a radiation resistance of about 90 Ohms, and a ten wavelength wire will show about 160 Ohms.

Knowing the radiation resistance and the impedance of the feedline, we can compute the theoretical swr of the system. This is done in the accompanying charts for three different antennas operated on the various HF ham bands. Obviously, if you started with a desired operating frequency and juggled the antenna length, you could improve the swr at your favorite frequency. I used the beginning frequency of the bands for computations for convenience, since everyone has his favorite band or set of frequencies.

Swr for Different Feedline Impedances

f	N	R	95 (Med.)	300	150	75	50
1.8	0.2	62	1.5	4.8	2.4	1.2	1.2
3.5	0.4	70	1.4	4.3	2.1	1.1	1.4
7	0.7	88	1.1	3.4	1.7	1.2	1.8
14	1.4	105	1.1	2.9	1.4	1.4	2.1
21	2.2	112	1.2	2.7	1.3	1.5	2.2
28	2.9	128	1.3	2.3	1.2	1.7	2.6

Fig. 2. Swr for a 100' endfed antenna.

See Fig. 1 for a rundown of swr for the 250' antenna previously described with different feedline configurations. If the formulas are correct, one could operate this antenna at about 1.5:1 on all bands by feeding it with a 110 Ohm line. The median feedpoint resistance is (70 + 150)/2. A match almost as good can be obtained by using a more conventional 75 Ohm line. This line would keep the theoretical swr at 2:1 or less on all bands. If you use coax, you probably should add a 1:1 balun at the antenna feedpoint.

Fig. 2 is a similar chart for the 100' antenna I'm presently using. Both of these antenna lengths were chosen because they represent the maximum amount of wire I could get into the air. The table shows I'd probably be better off with a 1:1 balun and 75 Ohm feedline, but the 4:1 balun is what I had.

I ran the figures for a 135' antenna because that's a length frequently recommended for a long wire, and it is about the length of an 80 meter dipole. Many hams manage to get up the conventional 80 meter antenna but don't think they have room for an allband design.

Note, too, that you get another plus as the frequency is increased or the antenna is made longer: directivity. When an endfed design is a half wavelength long, its gain is about the same as a centerfed design. The longer the antenna (the more wavelengths on the wire), the greater the gain. The direction of increased radiation is off the ends of the antenna, so at higher frequencies especially, it often helps to lay out your endfed wire with the help of a compass so you'll get greatest directivity in the direction you're most interested in working.

So practice and theory show that for getting out, an antenna tuner or swr meter is unnecessary. There may, of course, be feedline and antenna length combinations which are beyond the capabilities of a given transmitter circuit, and there is less likelihood of harmonic radiation with a tuner.

But I've shown by personal experience and theory that slavish dedication to often-repeated facts about swr and antenna design can knock you off the air. When you need an antenna you just know you don't have room for, string up something anyway. Feed it at the end using the formulas to help you choose a feedline, make sure you're not causing RFI somewhere, and if it'll load, you can work about anything you can hear. ■

Swr for Different Feedline Impedances

f	N	R	96.5 (Med.)	300	150	75	50
1.8	0.27	60	1.6	5	2.5	1.3	1.2
3.5	0.51	70	1.4	4.3	2.1	1.1	1.4
7	0.99	90	1.1	3.3	1.7	1.2	1.8
14	1.95	112	1.2	2.7	1.3	1.5	2.2
21	2.91	128	1.3	2.3	1.2	1.7	2.6
28	3.87	133	1.4	2.3	1.1	1.8	2.7

Fig. 3. Swr for a 135' endfed antenna.

Charles Klawitter W9VZR
4627 N. Bartlett Ave.
Milwaukee WI 53211

Recycle Your Receiver

-- tips for hamfest specials

I guess I'm the kind of ham that you would have to call a receiver nut. For about twenty-five years I have had the opportunity to own most of the commercial receivers available to hams. Many of these were outstanding, high quality, instruments which were a pleasure to own and use, and, of course, some were very poor, almost useless.

Unfortunately, today most receiving instruments are only a part of a transceiver. It is difficult to buy a quality receiver by itself, especially on a budget. The obvious solution is purchasing an older receiver and reconditioning it both mechanically and electrically. If you are a real receiver nut like myself, you will also consider a face lift for the old beauty. I imagine the antique car buffs would understand that quirk in my personality.

The reason I decided to rebuild the Hammarlund BC-779-B is very simple. Someone was kind enough to give me one. It also was an excellent receiver in its day, the early and middle forties — shades of Glenn Miller!

It also is an eighteen tube gem, the first of the Super-Pros, with one of my favorite characteristics, the external power supply. This is a great way to keep heat and intense magnetic fields out of the receiver proper. It has a fine quality sliding band switch which proved perfectly troublefree after all those years of use. It tunes to twenty MHz, has a good crystal filter, and enough BFO injection and stability to work reasonably well on SSB. Something like that could cost several hundred dollars new and only weigh a fraction of this boat anchor.

Now that I have established the fact that this project is worth the effort, let me give you some tips for the successful completion of this labor of love and lunacy.

I would suggest that before you begin any major work on this project that you check to see that the machine works. It does not have to be in top notch order, but it is helpful to establish this before you begin disassembly. A schematic, or better yet a manual, can be a real lifesaver. I was lucky to be able to purchase one from Fair Radio Sales. Other sources might be W3LHD for military surplus equipment, Sams Photofact, or the manufacturer.

The power supply for my BC-779-B was in terrible condition and weighed more than the receiver. It looked like it had been dropped from an airplane or run over by a tank in World War II. I built a new, much lighter supply, that I could easily store under my operating table. I added some voltage regulation for oscillator voltages and screen voltages. The screen voltage made a large change in the receiver gain for less than a five percent change in the supply voltage. I went all the way and used a three wire

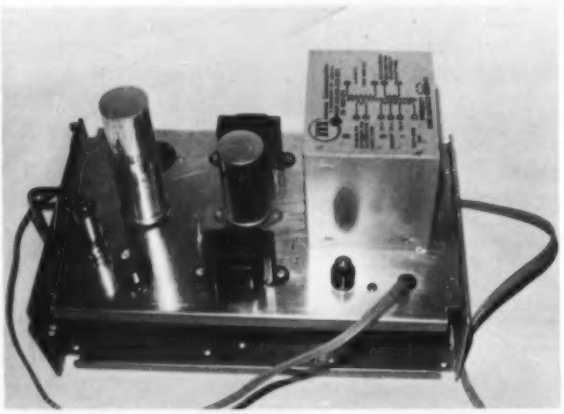


Fig. 1. The new power supply for the BC-779-B.

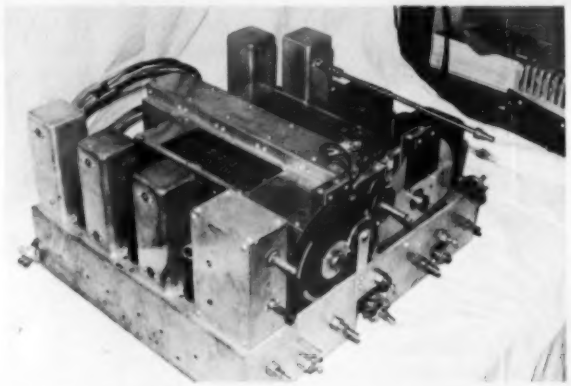


Fig. 2. "Old Faithful" with the front panel removed, ready for cleaning and repair.

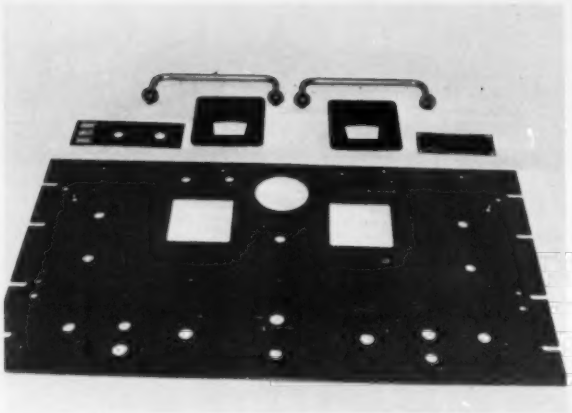


Fig. 3. Newly painted front panel with handles, escutcheons and name plate.

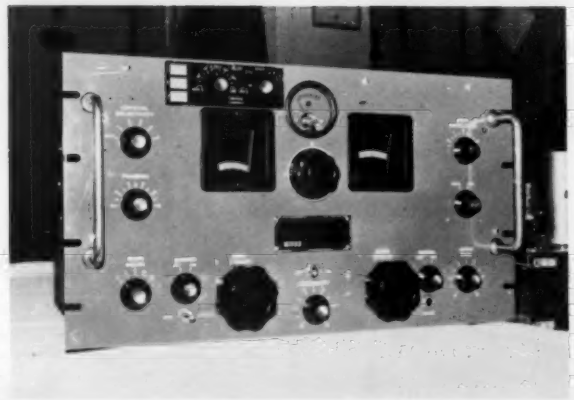


Fig. 4. The completed receiver.

line cord to complete the supply. Fig. 1 shows you how the new supply looks.

When I had the receiver working (no AVC yet, that would come later), I decided to remove the front panel and refinish it. Be careful so that you do not lose any parts. Use a plastic pan to keep track of all the hardware and other parts. If the dial markings are not etched into the panel, make a drawing of the panel and the location and names of all the controls. Fig. 2 shows the receiver after the front panel was removed. All of the panels I have worked with have been either steel or aluminum. The method of refurbishing that I will explain has worked well with both types of panels. First strip all the paint from the panel. Use a good quality liquid stripper. A pint should be sufficient. Read the directions carefully and heed all warnings. When the paint has been removed, it is a good idea to remove any grooves or burrs. Make the panel as smooth as possible. A primer is very important to getting a good final finish. Buy a good metal primer, close to the finish color of the panel. I have had good luck with auto primer. Use several light coats to prevent runs and bubbles. It is helpful to bake the primer. In winter, I put the panel on a ledge of my heating unit. If the cook in your home is rather liberal, you may be able to bake the panel in the oven at 200° for a few hours. If the first coat is not consistent, add a second coat. Be patient. Allow at least twenty-four hours in between coats of primer or finish. If you are like I am, you will have a tendency to want to get the painting done quickly to see some results ... resist the temptation! You will hate yourself in the morning if you don't. Now apply a coat of the finish color. Rub it out after twenty-four hours. I use an inexpensive auto rubbing compound. Use at least two or three coats of finish. This will give you more ability to rub out imperfections. You could use a spray paint color which is available at a paint or hardware store, or you could go custom by having a color mixed at an auto paint distributor. Fig. 3 shows the repainted front panel, escutcheons, name plate, and handles.

Congratulations! You now own a beautifully painted metal panel ready for lettering or decals. Easy now. This is your last chance to really guff-up your work of art. My panel was engraved, so all I had to do was work white tempera into the panel and let it dry. For my finishing touch, I paste-waxed the panel with Johnson's Paste Wax and lovingly buffed it until I was satisfied with the results.

Because of the weight of the receiver, and to add some aesthetic quality, I added six inch handles to the panel. The handles also make it possible to lay the receiver on its face for servicing. The escutcheons were sprayed flat black and a cracked plastic window was replaced with new plastic. The old knobs can be cleaned and small scratches removed by using rubbing compound and then paste-waxed them. New knobs, or knobs of more appropriate size, for tuning or bandspread may be added. I used larger knobs for the tuning functions. It gives the same effect as increasing bandspread. Fig. 4 indicates the modern appearance of the new paint and knobs on the thirty-five year old beauty.

Now is a good time to test the tubes and clean the chassis. I used clorethane for the chassis, along with a toothbrush and a smaller brush for all those tough corners. Some of the plated parts such as covers and chassis supports can be polished with SOS pads and then sprayed with a clear plastic such as Krylon's Crystal Clear. If there are any markings on the chassis, they should be renewed. Remark them now. If you put it off, you will never do it. Fig. 5 shows the cleaned chassis and new power supply.

After the refinished panel was again installed, it was time to complete the electrical repair. The AVC problem that I had mentioned earlier was due to a shorted capacitor in the screen circuit of the AVC amplifier. The short had opened a 2000 Ohms screen supply resistor. I felt it would be a good idea to replace all the thirty year old capacitors at this time, especially those used for bypassing and coupling. This was

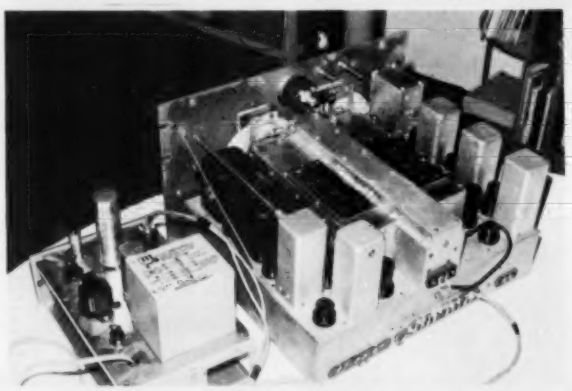


Fig. 5. Cleaned chassis, new power supply and interconnecting cables.

Fig. 6. The "gift receiver" recycled and ready to operate.

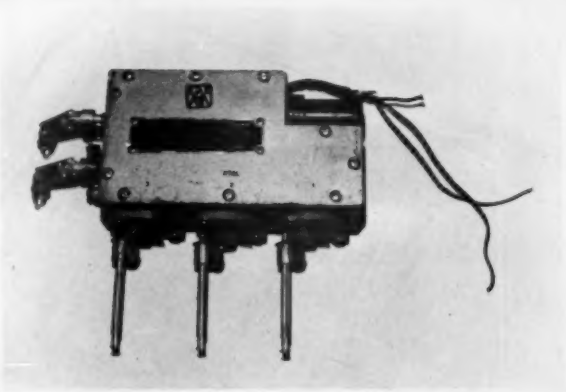


Fig. 7. The MC-531 crystal controlled oscillator modification kit.

easily done because there is ample room under the chassis. I checked several resistors and found them to be well within tolerance, so I did not replace any resistors in this set. This was quite unusual, in my experience, because I have found that older pieces of electronic gear suffer from many resistors which have changed value well beyond 20 percent. I also replaced an AM-CW toggle switch with a rotary switch so that the front panel would be authentic and have the correct number of knobs and switches. Fig. 6 shows the completed receiver and power supply prior to installation in the station console. The last modification that I made to the receiver was the removal of an earlier modification. This was the MC-531 crystal oscillator which made the receiver capable of three additional crystal controlled frequencies like its newer brother, the SP-600 JX. My reason for doing this was the poor way in which the oscillator was tied into the receiver. It extended the receiver oscillator circuits and made them vulnerable to mechanical vibration and instability. The MC-531 plate and knobs were left on the front panel of the receiver to cover up the holes. Fig. 7 will give you an idea of what this unit looks like.

Before final alignment I decided to let the receiver run for long periods of time over a two week time span. This usually will cause weak components to fail and save a lot of trouble later on. During this time I got used to the controls and the operating characteristics of the old Super-Pro. The more I operated it, the more I enjoyed it. The removal of the MC-531 oscillator cured any doubts I had about the oscillator being stable enough to use on twenty meter SSB and the crystal selectivity impressed me when using it for CW. Believe it or not, there is a phono input which gives reasonable quality audio out of a pair of 6F6s. What more could a person ask for in the well-equipped ham shack?

Now let's get to the alignment. I borrowed the best signal generator I could find, another big, heavy surplus tube-type device, called the AN-TRM/1. I allowed both the generator and the receiver to warm up for several hours, along with the basement ham shack. I have never known such a cold winter! As with most quality receivers I have aligned, this one was a breeze. The manual was specific and complete. The i-fs were tuned with air padders, real class! The rf alignment went just as smoothly as the i-f and I was able to get a nice even response across each band from one end to the other. I calibrated the 5 meter according to the manual, 50 microvolts gives an S9 reading at 3.5 MHz. For a change, I have some idea what the S-meter reading really means. The alignment took an evening, which was an enjoyable way for me to spend that period of time. It was the culmination of a couple months of part time labor which had a happy ending. For me, there was a great deal of pride in recycling an old piece of electronic gear into a useful and pleasant surprise which should keep going for many more years.

So far there has only been one unusual quirk in the operation of "Old Faithful." Occasionally when I am listening to shortwave broadcasts late at night, I will hear strange sounds like the music of Glenn Miller and Benny Goodman floating ethereally through the speaker when I tune to a place near 20 MHz around the old haunts of WWV. ■

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Build A Double Bazooka

- - give your signal a blast

William Vissers K4KI
1245 S. Orlando Ave.
Cocoa Beach FL 32931

An interesting fourteen page mathematical analysis of why the coaxial dipole antenna doesn't work for the average amateur appeared in the August 1976 issue of *Ham Radio*. I did a double take when I first read it. About a year ago, after having been off the air since 1935, I decided to get back on. My bright and new Yaesu FT-101-B worked fine, but a simple broadband antenna was needed for the 80 meter band. It seemed that a double bazooka, or coaxial dipole as it's also called, would be just the thing.

Before I built one, I did a bit of thinking as to just what made a double bazooka work. I realized that a very simple change would make it work a lot better than any of the ones previously described in the literature I had read. After reading the referenced article, I decided to repeat my previous experimental work and also delve a bit deeper into why my double bazooka worked so well when the theoretical analysis proved the coaxial dipole wouldn't work.

Being an old-time ham, ex-W3RN (1928), possessed of more low cunning than high math, I want to say that I won't write a long mathematical treatise as to why my antenna works as well as it does. The mathematics of the referenced article are absolutely correct, so anyone reading the referenced article can go to it and repeat any or all of the math he likes.

Instead of analyzing a theoretical thin wire dipole in free space, we'll analyze a dipole antenna that more closely represents the characteristics of one built by the average amateur. Then we'll add the coaxial stub sections and see what happens. At the same time we'll observe the improvement in lowering swr by using my new parallel connection technique as opposed to the series method previously used.

Fig. 1. Basic dipole antenna.

This analysis will be theoretically calculated and the resulting curves shown. The curves will show the antenna without any stubs connected, then with the series method, then with the parallel method just developed. And, finally, I'll show the same kind of curves as actually measured at my coax line feeding the antenna from the transmitter. This will allow each amateur to make his own decision as to whether a coaxial dipole has any reason for being.

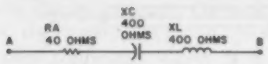
But one of the most compelling reasons for not going through pages of math is quite practical. Most average hams like myself are more interested in seeing actual results. Besides, anyone can check the math for himself from the referenced article. And now, as an example, I'll pull some figures and values out of a hat in midair and show some results. Later I'll explain just why I chose the figures I did. This way we can show the results first and figure out the whys and whereofs later on. I guarantee it will be a lot easier that way. Lastly I'll add a few general comments when I compare a double bazooka to other antennas designed for broadband usage.

Some Basic Theory

First, to refresh our memories and see exactly what we are going to explain, let's think about a simple dipole antenna as shown in Fig. 1. It is a wire an electrical half wavelength long with an insulator in the center where our feedline will attach at points A and B. And we know that for practical purposes our antenna at resonance can be represented by the simple series circuit of Fig. 2. R_a is the antenna resistance. X_1 is the inductive reactance, and X_c is the capacititive reactance in Ohms. Also at resonance, X_1 is equal to X_c numerically, but of opposite sign. And so at resonance our impedance is simply R_a. The Q of the antenna is X_1/R_a. Z_c is the impedance of the feedline we will use, and for our purposes it will be 50 Ohms, as that's what is generally available and used by the average amateur. And also at resonance, the swr is Z_c/R_a when Z_c is larger than R_a, and the swr is R_a/Z_c when Z_c is smaller than R_a. And if we were really lucky and had an antenna with a resonant resistance of 50 Ohms, our swr would be simply R_a/R_c or 50/50 or 1:1, and you can't improve on that.

There is not only one fly in the ointment, but at least three big ones and a few smaller ones buzzing around, as I'm sure you have already guessed. First, our antenna resistance is not always 50 Ohms. It can be either higher or lower. Second, and more importantly, is what happens when we tune our transmitter

Fig. 2. Basic dipole antenna resonant at 3.75 MHz. Q = 10, swr = 1.25:1.



to some frequency away from resonance. Then there is the third fly of basic antenna Q, which will have an important effect on how well our double bazooka antenna works.

But let's first stick with our basics a bit longer and see what happens, for example, when our antenna has a Q of 10 and a resonant resistance of 40 Ohms. We'll assume, and for practical purposes we won't be too far off, that our basic antenna dipole resistance will stay at 40 Ohms over the entire 80 meter band. Let's also assume our resonant frequency is in the middle of the band at 3.75 MHz. Our X_1 will numerically be equal to X_C and will be equal to $X_1 = (Q)\ (R_a) = (10)(40) = 400$ Ohms. And our swr at resonance will be $Z_C/R_a = 50/40 = 1.25{:}1$ at 3.75 MHz.

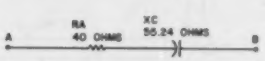
Now let's look and see what the antenna looks like at 3.5 MHz. Our inductive reactance will decrease to (400)(3.5 MHz)/(3.75 MHz) = 373.33 Ohms. Our capacitive reactance will increase to (400)(3.75 MHz)/3.5 MHz) = 428.57 Ohms. The difference will be 428.57 minus 373.33 which is equal to 55.24 Ohms. So at 3.5 MHz our antenna no longer looks like a pure resistance of 40 Ohms, but looks like a 40 Ohm resistance in series with a capacitive reactance of 55.24 Ohms, as shown in Fig. 3. And the calculations for the swr of our antenna at 3.5 MHz with the 50 Ohm coax feeder tied on turns out to be 3.27:1. As I mentioned earlier, the basic mathematics of the referenced article go into the details of how to calculate swr, and, as we didn't want to make this article too mathematical, we'll let it go at that. However, I'll do some more math calculations myself and just show the curves. It will save us all a lot of time and effort.

Well now that we've seen that our basic dipole has an swr of 3.27:1 at 3.5 MHz, we wonder if there is any way that we can reduce the swr to a lower value. Here is where the double bazooka comes in.

But before going directly to the antenna, let's see just what we are actually going to do. If we look at the characteristics of a parallel resonant circuit and compare it to the series circuit of our basic dipole, we will find some interesting things. Let us just arbitrarily take a condenser of 3600 pF and an inductance of .5 uH and connect them as a parallel circuit. It just happens that this circuit will resonate at 3.75 MHz. If we assume a perfect coil and condenser, the parallel impedance at resonance will be infinity. So if we were to place this parallel resonant circuit across the insulator of our basic dipole, nothing would happen at a frequency of 3.75 MHz.

But what happens to our parallel circuit by itself if we tune the transmitter to 3.5 MHz? With a bit of basic circuit theory, we find the parallel tuned circuit will be equivalent to an inductive reactance of 85.3 Ohms. And we already know that our antenna by itself at 3.5 MHz showed a capacitive reactance of 55.24 Ohms in addition to its resistance value of 40 Ohms. This tells us that when we look at Figs. 4 and 5, that the inductive reactance of the tuned parallel circuit at 3.5 MHz could be used in some manner to cancel all or part of the capacitive reactance of the antenna at this frequency.

Fig. 3. Basic antenna dipole equivalent circuit at 3.5 MHz. Swr = 3.27:1.



Another interesting thing is that the equivalent antenna resistance will no longer look like 40 Ohms but will be at some higher value. Fig. 5 shows the total equivalent circuit impedance of the combined system. The equivalent resistance is now 116 Ohms and the capacitive reactance has dropped to the extremely low figure of 2 Ohms. So we have seen that by picking the right kind of parallel tuned circuit, we can practically eliminate the reactive component at the band edge of 3.5 MHz.

A similar action would take place if we left things as they were and tuned the transmitter to 4 MHz. And now if we were to calculate the swr of the combined circuit at 3.5 MHz, shown in Fig. 5, we would find that the swr has been reduced to a value of 2.33:1. And, as our original swr without compensation was 3.27:1, we see that there is a way to reduce swr in an antenna.

It might be reasonably asked at this point, if we can theoretically reduce the swr of an antenna system with a simple parallel resonant circuit, why go to the double bazooka system? There are two basic reasons. First, we notice that the value of capacity required is very high and that the inductance is only .5 uH. To properly tune and build such a network tuned exactly to 3.75 MHz and install it across your antenna insulator would be quite a job. Second, it would be hard to build such a system using practical components and still obtain a high Q. Since we want the Q of the parallel circuit to be as high as possible for best results, this means we want the losses to be as low as possible.

Fortunately, a shorted quarter wavelength of coaxial cable will act like a high Q parallel tuned circuit. At the same time, the quarter wave sections will also act like a portion of the antenna radiating system. As a matter of passing interest, as it does have some bearing on our further discussion, we could in this example replace our parallel tuned circuit with a quarter wave piece of coaxial cable cut for 3.75 MHz. However, this piece of cable would have to have a characteristic impedance of nine Ohms. To my knowledge, there is no such kind of coaxial cable of this low impedance on the market available to the average amateur.

We know that our antenna will have two quarter wavelength stubs, one on each side of the center insulator. If we plan to use 50 Ohm coaxial cable, we can readily see that if we were to parallel the two stubs, we would get down to 25 Ohms. However, the double bazooka antennas used up to this time have all showed the two stubs connected a series, which gives a characteristic impedance of 100 Ohms. And we know that 25 Ohms is a lot closer to 9 Ohms than the

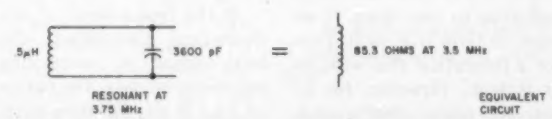


Fig. 4. Parallel tuned circuit.

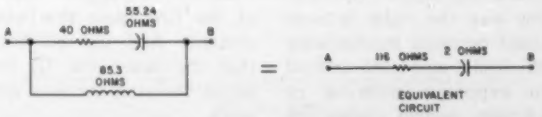


Fig. 5. Basic dipole antenna with parallel tuned circuit connected in at 3.5 MHz.

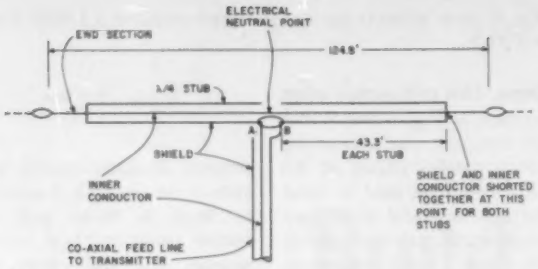


Fig. 6. Coaxial dipole series connected.

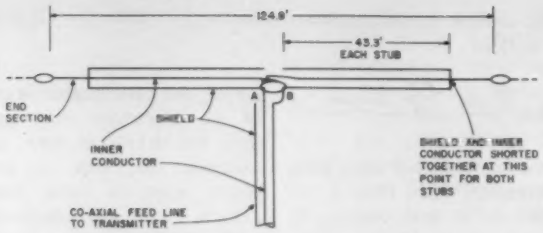


Fig. 7. Coaxial dipole parallel connected.

previously used series connection of 100 Ohms. The stub improvement ratio is a factor of four to one, which is nothing to be sneezed at in any antenna system. So if anyone already has a series double bazooka antenna up, all he has to do is to change over to the new parallel configuration and notice the marked reduction in swr. The series and parallel stub configurations are shown in Figs. 6 and 7.

The original coaxial stub antenna was designed by the staff of MIT for radar use. Their design shows a series stub system. Actually when you start from an original design and are not limited like we are to the use of 50 Ohm coaxial cable for feedline and stubs, the antenna system could be optimized using either a series or a parallel stub system. Naturally the feedline and stub impedances would be different for the two different types of antennas.

The series stub system was apparently used for a very good and simple practical reason. In the series stub system, there is an electrical neutral point where the center conductors of the coaxial stubs join, while the parallel stub system does not have such an electrical neutral. And the electrically neutral point of the series system was used as a mechanical support point. In this way the radar antenna could be easily mechanically physically supported without an expensive electrical insulating system being required. One would have been needed if the parallel stub method had been used.

Apparently, whoever first adopted the concept of a double stub antenna for amateur use just went ahead using the series stub connection without realizing that a parallel stub system is quite superior when using 50 Ohm coaxial line. But that's why I can't help but feel that basic concepts are sometimes better than high mathematics where you can easily lose sight of the basic objective which, to me, is to build an antenna with the lowest possible swr. And that's what this article is really all about.

Antenna Characteristics

Although we mentioned that the referenced theoretical mathematical analysis of a thin wire in free space was correct, there are a few things that should be further considered. There is no disagreement that the free space thin wire coaxial dipole will not work well in the series configuration using a 50 Ohm feedline and 50 Ohm stubs. But, and this is a very big but, the average antenna put up by the average amateur differs markedly from an antenna in free space. An analysis of a coaxial dipole using thin wire implies that there is such a thing as thin wire coaxial cable to be used for the stubs. There is no such thing. The very fact that coaxial cable has a finite thickness would lower the Q of the free space thin wire antenna. And we will find that the lower the Q, the better the stub sections will work.

But more important than the previous technical point is that the resonant resistance of an average amateur antenna is considerably lower than that of an antenna in free space. For a horizontal antenna to have a resistance of 73 Ohms, which is the same as free space resistance, the antenna height has to be at least a quarter wavelength high. And this, for our resonant frequency of 3.75 MHz, turns out to be 65.5 feet high. And in all honesty, how many average amateurs can boast of a pair of poles that high supporting a horizontal antenna 125 feet long? There are none in my acquaintance. Usually our average amateur is lucky if he can get up an inverted V with the center pole about 35 to 40 feet above the ground, with the ends sloping downward. Antenna resistance drops rapidly as the antenna height is decreased. Also, when an antenna is formed into a V, the resonant resistance decreases. Combining these factors and actual antenna resistance measurements, I have found that a good conservative value of antenna resistance will work out to be about 40 Ohms. And that, oddly enough, is the value we have used in our basic dipole calculations. This value is opposed to the theoretical free space value of 73 Ohms. And that is a big difference.

The other important factor is actual antenna Q. An antenna in free space does not have any losses except its radiation to free space, if we want to term it as such. Thus for a theoretical thin wire, its Q is high. However, for an antenna nearer the ground, there are a number of additional but unavoidable losses. These losses are ground losses, losses due to local buildings and bushes, and actual losses in the antenna system itself. My own measurements on amateur antenna systems have confirmed that such combined losses will have a marked effect on reducing the basic antenna Q. And after much thought, a Q value of 10 was chosen. And, as we mentioned earlier, a low Q of our basic antenna system will make the stubs relatively more effective. This fact has been known for some time in the construction of coaxial dipole antennas. Some amateurs even make the end sections of their coaxial dipoles out of open wire transmission line to reduce the Q. A very good example of this is shown in the 1975 ARRL *Amateur Handbook* in the description of a broadband dipole popularized by W8TV. He used open wire line for his end sections, and reported measured values of swr of 1.7:1 at 3.5 MHz and 1.9:1 at 4.0 MHz. But every amateur will have to make his own trade-offs in determining just how he wants to build his own antenna. In my case, I didn't use any open wire line for the end sections, but just extended the coaxial cable. And my own measured swr was a bit higher than obtained by W8TV.

Theoretical and Actual Measured Swr Curves

In the final analysis of any theoretical calculation, the best proof is correlating experimental data. The curves of Fig. 8 are the theoretical calculations of swr based upon an antenna that we had

assumed approached the characteristics of that put up by the average amateur. Curve A is the antenna without any stubs connected. Curve B is the same antenna with the quarter wave 50 Ohm stubs connected in series. And lastly, curve C shows what happens when the stubs are connected in parallel. It is very obvious that the parallel stub system is quite superior to that of the series connected system. And, as we had previously indicated, these calculations did not take into account feedline losses.

Fig. 9 is the proof of the pudding. The curve nomenclature is the same as Fig. 8. These measurements were made directly at the transmitter using two four inch Swan WM-1500 wattmeters capable of reading forward and reverse power. The meter accuracy is 10 percent at full scale. Swr calculations were made from the forward and reverse power measured. It was interesting to note that the actual measured data showed a better swr improvement than what the theoretical calculations had predicted. But the measured data clearly shows that a broadband coaxial dipole is an actual reality and not a mathematical impossibility. My own advice is, "Try one, you'll like it."

Final Observations

The final question that should be thought of is, are there any better simple broadband antennas for 80 meters than the coaxial dipole? In my personal knowledge, I don't know of any. The writer of the referenced article mentions such things as a multiwire fan shaped bow tie dipole invented by P.S. Carter of RCA and used since 1937 to obtain the bandwidth necessary for television. This is correct, but when we magnify such an antenna to the proportions needed for an 80 meter antenna, I would suspect that just the mechanical construction would be a bit formidable. He also mentions the work done by Dwight Borton W9VMQ titled, "80 Meter Bow Tie Antenna," *Ham Radio*, May, 1975. This is an extremely interesting article to read. However, from the curves shown by W9VMQ, the double bazooka antenna shows a lower swr than a bow tie antenna made of regular copper wire. It is only when the bow tie antenna was constructed out of galvanized wire, rather than regular copper wire, that the swr of the bow tie was lower than that of the coaxial dipole. Unfortunately, this fact was not brought out by the writer of the first referenced article. It should be quite apparent that the swr of any antenna system can be lowered by using wire with a higher electrical resistance than regular copper wire. But why intentionally introduce losses that are not necessary? That's a trade-off that every amateur will have to decide for himself. My final advice is to "keep your bazookas up and your swr down!"

Antenna Length Calculations

The following information is used in calculating the lengths of the stubs and also the overall length of the antenna. Calculations are shown for an antenna that is resonant at 3.75 MHz. All dimensions are in feet.

$$\text{Stub length} = \frac{(246)(\text{Velocity factor of coaxial cable})}{\text{Frequency in MHz}}$$

And, assuming we use RG-58/A, we look up in the antenna handbook and find it has a velocity factor of .66.

$$\text{Length of each stub} = \frac{(246)(.66)}{3.75} = 43.3 \text{ feet}$$

The antenna overall length is calculated using the equation:

$$\text{Length} = \frac{468}{\text{Frequency in MHz}}$$

$$= \frac{468}{3.75} = 124.8 \text{ feet.}$$

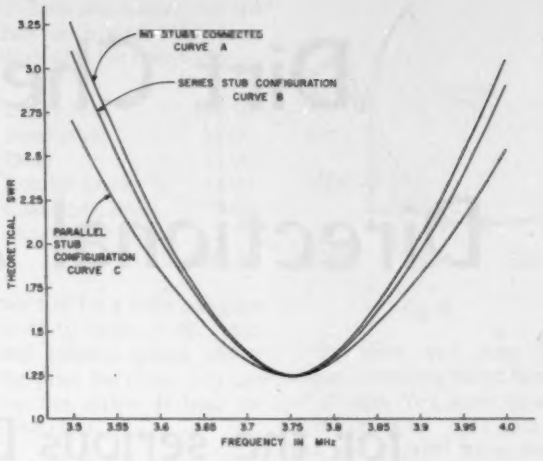


Fig. 8. Theoretical calculations for dipole antenna. R_A = 40 Ohms, Q = 10, resonant frequency at 3.75 MHz.

If it is desired to make experimental measurements to see what the swr of your antenna is without the stubs connected, it can easily be done as follows. Just connect the center conductor of each coaxial stub to its own shield. Leave the feeder connections as they were.

In Figs. 6 and 7 I've shown the feeder line of coax cable connected directly to the antenna without the use of a balun. My own antenna seems to work fine without a bulun, although a balun may make your antenna more electrically balanced.

It may be necessary to trim and adjust the overall length of the antenna to compensate for end effects and the presence of nearby objects. In my own case, I notice measurable changes in both antenna resonant frequency and swr when I even trim the hedge near the ends of my inverted V coaxial dipole. The ends are about twelve feet above the ground.

And, as previously mentioned, if you use something like an open wire line for your end sections, you will probably further reduce your overall Q and your band edge swr values. The swr you get is a function of several variables, and you'll find that experimentation is both fun and truly instructive, as it has been in my own case. ■

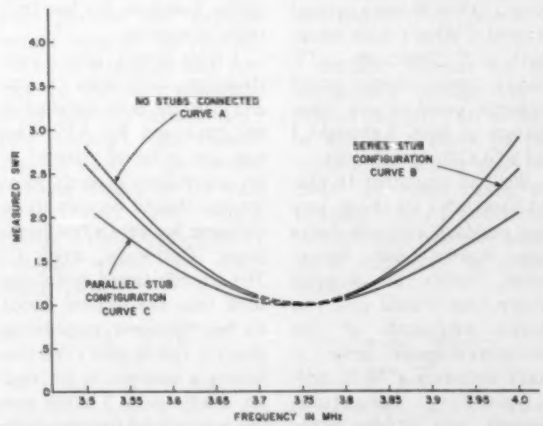


Fig. 9. Actual measured values of swr for inverted V coaxial dipole.

Dirt Cheap Directional Array

-- for the serious DX hound

Daniel P. Shaver WA4BKQ
7523 Todd Pl.
Manassas VA 22110

In my endeavors to achieve a halfway decent and readable signal for some rare DX station to pick me out of a pileup of California kilowatts and TH6s, I contemplated running up a $1000 bill and installing an antenna system that would give me armchair QSOs with FB8s. Other things made my early ham life as a two-bit DXer difficult and embarrassing: I am a high school student, and I have little spare cash. When I first joined PVRC, I was using a DX-60B and a vertical antenna ("What's your setup, Dan? ..." "Well, uh ..."). Finally, most hams would probably consider my ideas discrete at best. I thought I had a GOOD idea, though.

Well, all you other 16 year old hams who are cheap, lazy (but zealous), and with Extra class licenses but Novice minds, here's an antenna system that should cost you about one-tenth of the abovementioned price — that's including a 40 ft. self-supporting structure, antenna, and all the other junk you're going to need on the way. (Of course, this construction article is no different from the rest, so I might add here that you should adjust this liberal figure to about 1.3-1.5 times the abovementioned price if you are a conservative.)

The supporting structure (a complicated name for a utility pole) is of primary importance. I managed to give the guy down at the local electric company a combination sob story and snow job resulting in a 42 foot pole (used, of course) at 25¢ per foot. Yep, that's $10.50 for a self-supporting tower. Great, huh? With a little bit of luck, one should be able to swindle a used jobby from a local utility company for less than twice that price.

I then simply gave a construction contractor a call and had the pole installed in my backyard for $35. This was also a fervid attempt to get my money's worth. Most anyone should be able to do the same for only a few bucks more. (Optimistic, aren't I?) The gigantic tarred dowel was sunk into the ground about six feet; however, considering that my father didn't feel like having a sunlight in his roof on windy days, I made sure the pole would not decide to fall. The foreman assured me it would not ... Whew! My parents now consider the pole an eyesore, my neighbors consider it an attraction, I consider it a status symbol, and my fellow hams consider me an idiot.

As for the antenna ... beams are way too expensive, and a vertical would be downright stupid; I therefore decided on a quad. I managed to find a really good deal on a two element boomless — William's Antenna Company* sells a complete tri-band quad kit with everything (bracket, copperweld, insulators, gamma matches, clamps, etc.) except the bamboo spreaders for $25. It's a darn good deal.

The bamboo can be obtained by two methods. One is by going down to your friendly carpet dealer and picking up any surplus he has lying around, or one can go a la naturale as I did. I drove through a neighboring town last fall and found a whole patch full of strong, 15-20 foot high bamboo stalks. I knocked on the fellow's door, and within twenty minutes I had 15 nice straight, immaculate poles. The city slicker or northerner might find this method of obtaining bamboo spreaders difficult; on the other hand, this method is easy and practicable for those throughout the South. Bamboo is a grass and therefore sprouts quickly. If need be, you can even grow it in a wet place near your home. I don't, however, suggest this method for the supporting structure unless you have great patience. The bamboo is simply given two coats of good enamel paint, and they're ready to go.

Instructions in the WAC quad kit are extremely simple to follow, almost like Heathkit. Depending on what you want, though, one may decide to up the cost and buy a quad or beam or even down the cost by building one. I obviously preferred the compromise route and am thoroughly pleased.

Tuning comes next. I found that the easiest way of tuning the gamma matches on my quad was to mount it on a regular TV type bracket at a height of 10-12 feet up the side of the utility pole. This allows the stubs to be reached from ground level. (You ten meter buffs will probably have to use a ladder, but the effort is still a lot less than hanging off the side of the tower.) Remember that the resonant frequency of the antenna will rise three to five kHz for every foot the radiator is erected above ground, so tune your center frequency accordingly.

One feedline is all that is necessary if one uses the gamma match system. A tolerable swr can be obtained with direct feed, but cropping the wires is introduced. (This is more difficult than it seems, since there is quite a bit of tension introduced by the spreaders on the wires.) With either method, a suitable swr can be tuned in using a bridge in line at the input of the antenna. Another advantage of the quad, by the way, is that it is very broad banded and when tuned correctly, an swr of less than 1.9:1 can be expected plus or minus 250 kHz from a center frequency.

*404 Sanders Rd., S.W., Huntsville, Alabama 35802.

Finally, the hard part comes ... getting that 2500 cubic foot thing on top of that pole. Well, there's some good news and some bad news. First the good: The quad, especially if made out of bamboo, is a lot lighter than you might expect. The utility pole approach provides a strong and steadfast structure that will support the heaviest of hams. With a man on the ground and a man near the top, the antenna can be hoisted to its apogee with a simple pulley or gin pole arrangement. Now for the bad news: Climbing a wooden pole is more easily said than done. By all means, watch your step if you decide to use hooks. I, for one, though, prefer having the steel spike type steps on the tower. They make climbing easier and more sure. Don't make the mistake I did: Have those steps bolted in *before* the pole goes up; putting them in after is not impossible, but is considerably more difficult. Either way, always use a safety belt!

At last, the antenna is erected. A TV chimney mount was used in this case along with small wooden blocks (Fig. 1). A pipe or short mast is bolted to the mount so that 12-18 inches protrude from the top of the pole ... and the rotor's connected to the pipe, and the antenna's connected to the rotor.

All that's needed now is to run your coaxial lines and rotor cable to your shack. By the way, an el cheapo used TV type rotator will suffice for the quad. I must emphasize again that the weight of the antenna is extremely small. (Just don't put a 20 foot mast on the antenna ... keep the length of the mast between the quad bracket and the rotator as short as possible.)

Of course, there are many variations to this antenna scheme (e.g., a beam instead of a quad), but if the preceding information is closely followed, the whole thing can be built and erected for less than or around $100. Let's recap what has been spent ...

Utility Pole	$10.50
Installation	35.00
Quad	25.00
Rotator (used)	15.00
Coax and Cables	11.00
Mounting Bracket	2.75
TOTAL	$99.25

Not bad for a truly *complete* 20-15-10 meter, 7 dB, rotatable antenna system, eh? If the price backfires, you can use this article at least for some ideas.

Performance

Even when the quad was on the ground for tuning, it exhibited exceptional gain. I made many first shot QSOs with several Soviet and European hams with mostly 58-59 plus signal reports. My rig is a barefoot HW-101, so I'm not using anything extravagant. The whole system really amazes me, and I'm sure it will amaze those who decide to try it.

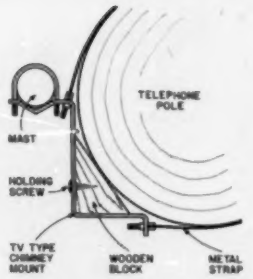


Fig. 1.

So there you have it, cheap, conniving, fervid hams of all ages. You won't be an armchair DXer right away, but give yourself some time (and the antenna a chance). Even dirt cheap directivity makes all the difference in the world. Good luck (you'll need it), and I'd be interested in hearing how your antenna party goes.

Special thanks go to WB4DHW who helped materialize the initial part of the project, to WB4TBO and W4WRJ for their technical assistance, and to my family for putting up with me. ■

R. P. Haviland W4MB
2100 S. Nova Rd., Box 45
Daytona Beach FL 32019

Instant PS Regulation

-- a quickie

Need an additional regulated supply in a hurry, perhaps to finish up some project which requires a special voltage, or perhaps the regular supply is just overloaded? If you have a source of dc voltage higher than the voltage you need, you can make the regulator by adding only two components, a transistor and a battery. The circuit is shown in Fig. 1 for both positive and negative output supplies. As you see, the battery supplies base current to the pass transistor, which acts as a variable dropping resistor. The battery drain is equal to the current supplied divided by the transistor gain. The output voltage is equal to the battery voltage minus the base-emitter drop.

If closer control of the output voltage is needed, it can be obtained by adding series diodes as shown in Fig. 2. Also, if better regulation is needed, it can be obtained by using a pair of transistors in the Darlington connection, as shown in Fig. 3. This connection is also worthwhile if the supply is to be operated for any length of time, since the battery drain becomes very small.

Suitable sources for the unregulated voltage are a battery charger, a car battery, or an old filament or bell transformer with a series rectifier. In many cases, the charger or transformer-rectifier does not even need a shunt capacitor to reduce ripple. ■

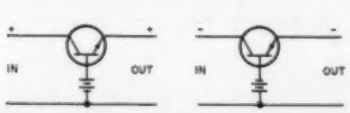


Fig. 1. Basic regulator.

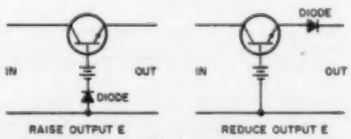


Fig. 2. Voltage adjustment.

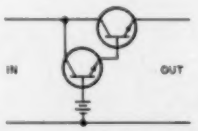


Fig. 3. Improved regulation.

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ACCURACY: ±1 count ± time base accuracy)
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SENSITIVITY: 30 mV (50 Hz-30 MHz), 100 mV (10-50 Hz; 30-60 MHz)
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INPUT IMPEDANCE: 1 MΩ
MAX. INPUT VOLTAGE: ±100 VDC; 250V RMS (10 Hz-500 kHz) to 5V RMS (25-60 MHz)
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OUTPUT: 2 MHz-51.2 MHz, 100 mV RMS
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41-141 10MΩ, 10:1 Probe	24.50

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LOW COST, rugged digital multimeters small enough to fit in the palm of your hand
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DISPLAY: 0.33" high
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POLARITY SELECTION: Automatic
DECIMAL: Positioned by range switch
SIZE: 2.7 x 1.9 x 4" deep
WEIGHT: 9.2 ounces

MODEL	LM-3A (3 digits)		LM-3.5A (3½ digits)		LM-4A (4 digits)		LM-40A (4 digits)	
RANGE*	INDICATION	ACCURACY	INDICATION	ACCURACY	INDICATION	ACCURACY	INDICATION	ACCURACY
1VDC	.999	±(1% rdg ±2 digits)	1.999	±(0.5% rdg ±2 digits)	.9999	±(.03% rdg ±2 digits)	.9999	±(0.1% rdg ±2 digits)
10VDC	9.99		19.99		9.999		9.999	
100VDC	99.9		199.9		99.99		99.99	
1000VDC	999		1999		999.9		999.9	
1VAC	.999	±(1% rdg ±2 digits) 50-400Hz	1.999	±(0.7% rdg ±2 digits) 50-400Hz	.9999	±(0.2% rdg ±2 digits) 50-400Hz	.9999	±(0.3% rdg ±2 digits) 50-400Hz
10VAC	9.99		19.99		9.999		9.999	
100VAC	99.9		199.9		99.99		99.99	
1000VAC	999		1999		999.9		999.9	
1KΩ	.999	±(1% rdg ±2 digits)	1.999	±(0.5% rdg ±2 digits)	.9999	±(0.1% rdg ±2 digits)	.9999	±(0.2% rdg ±2 digits)
10KΩ	9.99		19.99		9.999		9.999	
100KΩ	99.9		199.9		99.99		99.99	
1000KΩ	999		1999		999.9		999.9	
1MΩ	.999		1.999		.9999		.9999	
1mA	.999	±(2% rdg ±2 digits)	1.999	±(2% rdg ±2 digits)	.9999	±(2% rdg ±2 digits)	.9999	±(2% rdg ±2 digits)
10mA	9.99		19.99		9.999		9.999	
100mA	99.9		199.9		99.99		99.99	
1000mA	999		1999		999.9		999.9	

* = 1000V AC or DC max. Input any range

PLAIN CASE	Model LM-3A $125.00	Model LM-3.5A $147.00	Model LM-4A $227.00	Model LM-40A $190.00
TILT STAND	Model LM-3A/LH $128.50	Model LM-3.5A/LH $150.50	Model LM-4A/LH $230.50	Model LM-40A/LH $193.50

ACCESSORIES

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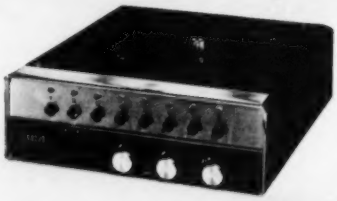

MODEL 16S300
8 Channel 3 Band
With Adjustable Scan Delay

30-50 MHz (VHF-Lo) 450-470 MHz (UHF)
150-174 MHz (VHF-Hi)

$114.50

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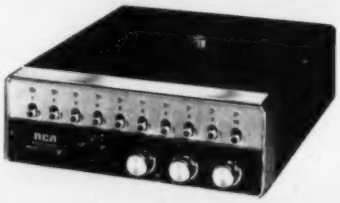

MODEL 16S400
10 Channel 4 Band Varactor Tuned With Adjustable Scan Delay and Speed Control

30-50 MHz (VHF-Lo) 450-470 MHz (UHF)
150-174 MHz (VHF-Hi) 470-512 MHz (UHF"T")

FEATURES:

- Automatically monitors public service broadcasts
- Each channel programmable for every band
- Separate lock-out switch for each channel
- LED channel indicator lights
- Easy access to crystal compartment
- Operates on 120 volt AC or 12 volt DC
- Noise squelch control
- Automatic and manual scan control
- Two-speed scan control (16S400)
- Variable scan delay control —0 to 4 sec.
- Solid state with integrated circuits
- Varactor tuned for full UHF coverage (16S400)
- Dual conversion I.F. —10.7 MHz and 455 KHz
- Crystal filters for selectivity
- Built-in speaker
- External speaker and antenna jacks
- Separate VHF and UHF telescoping antennas
- Two power cords —12V DC and 120V AC
- Mobile mounting bracket
- Size: 7-3/4" (W) x 2-5/8" (H) x 8-1/2" (D)

Crystals are not included with any model since they must be selected for local use by purchaser.

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- Uses single RCA 120 volt adapter (optional) for charging and AC operation
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- Automatic and manual scan control
- All solid state with integrated circuits
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- Crystal filters for selectivity
- Drift free ceramic discriminator
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4 Channel 2 Band
30-50 MHz (VHF-Lo)
150-174 MHz (VHF-Hi)
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MODEL 16S150
4 Channel 2 Band
150-174 MHz (VHF-Hi)
450-470 MHz (UHF)
$119.50

MODEL 16S200
4 Channel 2 Band
450-470 MHz (UHF)
470-512 MHz (UHF"T")
$114.50

ACCESSORIES FOR POCKETTE SCANNERS

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Voltage regulated unit permits Scan-Aire operation from 120 volt AC while at the same time recharging nickel cadmium batteries.

DC Auto Adapter
Model 16S102
Permits operation from 12-volt lighter socket in car

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Model 16S103
Black case with built-in belt loop.

Flexible Antennas
Model 16S104 For VHF 150-174 MHz
Model 16S105 For UHF 450-512 MHz

Model 16S101	$7.95
Model 16S102	$5.95
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Model 16S104	$7.50
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Take Cover!

-- how to prevent antenna wind damage

I had worked for five years gathering the parts for my antenna system, and two years ago I finally got it in the air. It withstood winds of 70 miles per hour last summer. But then, with winds the weather bureau said were gusting to only 45 miles per hour, the antenna system came down.

The tower was 60 feet of Rohn 25G mounted by four 3/8" stainless steel bolts to the Rohn tilt-over base plate. This hinged base plate was fastened with two bolts forming the hinge. The other two held the plate from unwanted hinging, or, one might say, they held the hinge-plate from opening away from the base plate. The base plate was fastened to a four foot by four foot by five foot deep concrete block with ½" steel bolts. The tower was guyed at the thirty foot and forty foot levels with 1/8" stranded steel wire, plus additional 1/8" steel guys to the ends of two 10 foot side mounted arms. One side arm carried a TV antenna and the other a Hy-Gain Model 341 two meter beam.

The Ham-M rotator was mounted inside the tower at the 50 foot level, with a 1½" galvanized pipe mast extending through the top section bearing. Extending upward from this mast was a 10 foot mast with a Ringo-Ranger two meter vertical antenna on top. The TA-33 triband beam was mounted just above the top of the tower. At the 40 foot level on the tower was attached an inverted vee dipole of aluminum coated steel wire for 80 meters. This inverted vee was used as part of the guying system. Just above this antenna was a 19" side arm with a two meter 19" spike ground plane antenna used with my scanner.

The top set of guys on one side was attached to the chimney at about 45° from the tower. The other two guys went to screw type ground anchors, also at 45° from the vertical. The three sets of guys were spaced equidistant around the tower (120° from one another). All guys were broken into appropriate segments with egg insulators. Each segment of guy wire was secured by making two half hitches and then a tight wrap for 3-4 inches, with the loose end secured to the guy with a cable clamp.

The system was theoretically designed for 100 mile per hour winds. However, plans were that, if winds in excess of 60 miles per hour were predicted, the tower and antenna assembly could be lowered to ground level with a block and tackle mechanism attached at the thirty and fifty foot levels with a bow of ¼" aluminum and steel wire.

In designing the antenna system I had to keep in mind two major environmental factors: 1) We are close to the Gulf of Mexico (about 13 miles) and we get considerable salt in the air, which makes the air quite corrosive; and 2) this part of the Texas gulf coast is subject to hurricanes.

The postmortem examination of the antenna system suggested, but did not establish beyond a shadow of a doubt, several possible causes for the system to fail.

Several amateurs viewing the twisted wreckage were of the opinion that only a tornado, or similar twister, could have done the damage. They speculate that the twister came low enough to strike the top of the tower, but not the house. An alternative explanation was the harmonic effect of repeated gusts of wind, each amplifying the effects of the previous gust. No one thought a straight wind could have caused the damage.

This raises a question of wind effects we do not usually consider when designing an antenna system, namely the reinforcement of wind pressure by harmonic gusts. Similarly, reflections of a blast wave, if reflected in the proper phase, can at least double the effect of the blast. You may recall a few years ago a suspension bridge in the Northwest succumbed to the effects of harmonic vibration of the wind.

Observation number one: *When designing an antenna system, consider both straight winds and harmonic vibration, and design the guying system to prevent or dampen harmonic vibration.*

This can be done by proper attention to guying and control of any side arms on the tower to prevent the wind from catching the side arms and starting them vibrating.

On a guyed tower, the use of three guys at each level, each guy at 120° points on the tower with the guy running to a ground anchor (distant from the base of the tower equal to 60 to 80 percent of the height of the tower), is more stable than the use of four guys at each level. The levels at which a tower is guyed depend upon the height of the tower and whether or not a house-bracket is used. I prefer to place the first set of guys at twenty feet above the ground or twenty feet above the house bracket, whichever is higher. Some amateurs prefer the first set of guys to be at the 30 foot level. The second and subsequent sets of guys should be placed at twenty foot intervals.

What type of guy wire should be used? In the past I have used nylon rope, sisal rope, glass rope, and 1/8" and ¼" stranded steel wire. In our area, the various ropes, including glass, are rapidly destroyed by the effect of the sun and the salt air. I have used these ropes as halyards for longwire and dipole antennas and find the rope disintegrates in two years or less. Also one must consider stretch when using ropes. Nylon is particularly bad in this respect.

Steel wire corrodes rapidly in the coastal area, particularly where two dissimilar metals join (corrosion due to electrolytic effect). I have found plastic coated stranded steel to last longer and to be more effective than other guy wires. However, although 1/8" stranded steel wire may hold telescoping masts, or hold towers in other areas of the country, the lesson I have now learned is to not trust anything less than 3/16" to ¼" noncorrosive steel wires in the Texas gulf coast.

What about aluminum wire or copper coated steel wire? Aluminum is too soft, stretches and breaks easily. Copper coated steel may be satisfactory, but I have had no experience with it and therefore cannot recommend it.

Observation number two: *Fastening of guy wires should not be sharply kinked nor pull out easily.*

A double set of properly applied cable clamps would be the most desirable method of securing guy wires. Second choice would be to take 10-12 tight wraps of the free end around the guy and then clamp the remaining free end. There should be no sharp bends in the guy wire where any strain is applied. If you get a kink in your guy wire, don't put that section up. Cut it at the site of the kink and splice with an egg insulator.

Any side arms stretching more than three feet from the tower should be separately guyed from the end of the arm in at least two opposite directions.

Observation number three: *Prevent the tower from twisting due to wind or torque of the rotator.*

Several rotators have a braking action that applies considerable torque to the tower when they stop a rotating beam. A number of years ago the idea was proposed of using a heavy spring in the mast between the rotator and the beam. This heavy spring absorbs the torque. (I apologize to the author of the idea, as I do not remember his name nor the journal in which the article appeared.) Caution should be shown in selection of the spring; it cannot be too limber nor too heavy.

A method for preventing twist in a tower uses two guys to each point of the top level of guys and separates the top end of each set of two guys by about one to two feet with an angle iron or similar strong brace. Each end of the brace should extend beyond the edge of the tower by at least six inches. A guy is fastened to each end of the brace.

Observation number four: *Do not use dissimilar metals in contact that are exposed to the effects of moist air or rain.*

I have observed that even when protected by RTV or other sealant, dissimilar metals will corrode quite rapidly. This is particularly true of coax connectors.

One way to eliminate this corrosion is to thoroughly clean both coaxial connectors and then apply silicone grease to keep out the water. (Make sure that the electrical contact is not broken by the grease.) Wrap the connection with electrical tape and spray the tape with acrylic. Cover this joint with stretchable rubber tape and cover the rubber tape with another layer of electrical tape. (The rubber tape, when applied, should be stretched to about ½ its resting width.) Again spray the electrical tape with acrylic and cover the whole joint with RTV.

Of course, there are some junctions where this method cannot be used. On these, do the best you can with alternating layers of electrical and rubber tape (as above) and coat the whole thing with generous amounts of a compound like RTV.

Where joints cannot be adequately weatherproofed such as mast clamps and tower bolts, use weatherproof hardware, and stay away from dissimilar metals.

Observation number five: *Torque and shear pressures can be tremendous at hinges and other areas where a short and long arm around a fulcrum are involved.*

I was unable to measure shear pressures on the tower, but did calculate that when the tower was lying over at a 45° angle that there were at least ten tons of pressure at the end of the hinge plate. When my tower went over, it bent the base plate and two of the ½" steel bolts holding the plate to the concrete block. It also stretched and sheared two of the 3/8" stainless steel bolts, cracked three welds (two on the hinge plate and one on the base plate) and broke one of the tower stubs which had been welded to the hinge plate.

Observation number six: *Design your tower and antenna system to fall away from the house and power lines.*

I was successful in this part of the design. The tower, in falling, fell away from the house and power lines, striking and destroying only one small tree on the way down.

When placing your tower, be sure that it is more than the height of the tower from the nearest property line or electric power lines. The guys should be placed so that if a set of guys on one side breaks, the other two sets will pull the tower away from the house or power lines.

Observation number seven: *Read your insurance policy carefully.*

When I put up the antenna system, I had a special rider put into my homeowner's policy. Since I had over $500 in the system, I thought I insured it totally with a $100 deductible policy. After the tower fell, I contacted my insurance agency and found to my surprise it was not a $100 deductible, but a $100 maximum that the agent had written.

What can be salvaged from such twisted wreckage? It was surprising to us how much we could salvage in various innovative ways. The TA-33 looked like a pretzel, and one of the traps was broken internally. It appeared that most of the twisting of the aluminum elements was the result of the wind rather than the fall. Except for the aluminum support of the driven element, five of the six traps, and a couple of tip elements, I was unable to salvage any of the beam. However, it will probably be less expensive to replace the aluminum elements and the one trap, than to buy an entire new beam.

The two meter beam had three broken insulators, all elements bent and a bent boom. This aluminum can probably be straightened, and with three new insulators will probably work as well as new. The TV antenna sheared two bolts, but otherwise appears unharmed.

At first I thought I could salvage only four sections of tower and thus have only forty feet of tower. But here is where innovation came in. The 40'-50' section of tower was broken one foot from the lower end, and the mounting stubs on the base were broken. I cut off the broken end of the tower section and the stubs from the base plate, straightened the base plate and welded the shortened section of tower to the base hinge plate. A second section of tower was only bent and can probably be straightened, but I am not sure I would trust it. If this can be accomplished, I anticipate I will lose only about three feet of tower.

I hope that this recitation of my problems with this antenna system will help other hams to design and add more safety features to their antenna systems. I have not covered safety points such as wind loading, climbing towers, and others covered in the ARRL publications and the series of articles in 73. I would encourage you to read them before you next erect a tower or antenna system. ■

David F. Norman
622 W. Sunset Blvd.
Fort Walton Beach FL 32548

Introducing the Intenna

-- new concept for mobile ops

The Intenna, produced by Microwave Filter Company, Inc. (6743 Kinne St., E. Syracuse NY 13057), uses the old principle of a coaxially fed slot in a metal groundplane. While the concept is not new, the application of this principle to low band communications is almost revolutionary.

Figs. 1 through 4 show the evolution of the Intenna from theory to practice. The distortion introduced by the shape of the auto body does not adversely affect the performance of the antenna. On the contrary, such distortion makes the antenna effective in the directions most favored by motorists – fore and aft.

The Intenna is quite directional. The major lobes of radiation are obvious when a vehicle equipped with an Intenna and a CB or 10 meter unit is turned in a circle while receiving a base station or other fixed transmitter. When the sides of the vehicle are toward the other station, the received (or transmitted) signals fall off sharply. Continuing the turn until the front or rear of the vehicle is aimed at the fixed station causes a dramatic increase in signal strength. As mentioned previously, this characteristic of the Intenna is hardly a disadvantage for most motorists. The vehicles behind or ahead of the operator are usually the ones that he is most concerned with.

Fig. 1.

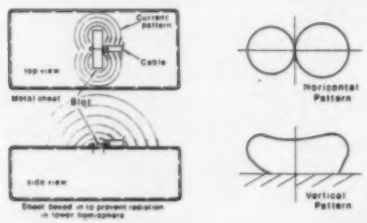


Fig. 2.

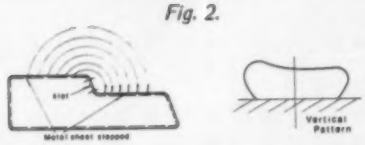


Fig. 3.

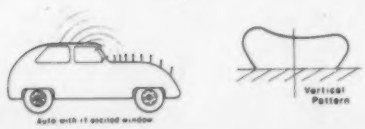


Fig. 4.

When I first heard about the Intenna, I said that there was no way that any antenna only 24 inches long could work as well as the flyer said that it could. My fellow workers agreed with me, but just for fun we decided to try one.

When I contacted Microwave Filter and expressed a skeptical interest, Glyn Bostick, President of Microwave Filter Co., promptly sent me two for evaluation. Even after seeing the Intenna and reading the poop sheet, I still didn't think that it could work any better than, say, a "shorty" gutter mount antenna. Boy, was I surprised!

It took me about an hour to install the Intenna. My 1973 Buick had no metal on the dash at the bottom of the windshield – the end of the wire which makes up the Intenna must be well-grounded if it is to work.

However, that was a detail which had been anticipated by the manufacturer. Included in the kit is a pointed brass rod with an eyelet on one end. I followed the instructions and pushed the rod through the rubber seal at the bottom of the windshield and, lo and behold, I had easy access to the rod on the outside of the car (just under the edge of the hood).

I trimmed the wire which comes down the windshield from the tiny tuner (which mounts at the top of the windshield under one of the screws fastening the inside molding to the body), and attached it to the rod as per instructions. As soon as I was certain that both ends were properly grounded, I connected the 8-foot piece of coax supplied with the kit to the tuner.

Also included in the kit are four self-sticking cable clips. These make it simple to route the coax around the inner windshield molding to the radio itself.

Now, according to the instructions, I was ready to begin tuning the tuner box for minimum vswr. Here was where I ran into trouble for the first time. I simply could not make the tuner do its thing. After running carefully through the instructions several times, I decided to call the factory and see what might be wrong.

On the front cover of the dealer package sent to us is a number to call collect – that's right, collect – if problems are encountered with tuning. When I called at about noon on a Saturday, I was given an "800" number (inward WATS) to call. The technician who came on the line was quite courteous and sincerely interested in helping. He asked me a few questions, offered a few suggestions, and told me to call him back and let him know how I came out. He also told me that if I couldn't get it working, he would try to arrange to come down and tune it himself.

When I asked whether I was being put on or not about him traveling over 1000 miles to tune an antenna, he assured me that his job was doing just that. I later talked with Glyn Bostick

about this. Glyn told me that he was doing whatever was necessary to see that all Intenna customers were happy. He said that he felt that early adverse publicity would be much more expensive in the long run than would be an all-out customer relations program. (I was reminded of the policy of a few manufacturers of much more expensive items – fly a man around the world if you have to, but make him happy.)

After talking with the technician (Mr. Tuner, he is called), I went back to my tuning. I found that the best adjustment was obtained with one of the tuning screws backed all the way out. I decided that perhaps my particular automobile has characteristics which need less capacitance than the minimum provided by the tuner. Experimentally, I removed one of the tuning screws and reinstalled the tuner. This time the vswr went down to zilch at the center of the band and to about 1.2:1 on either end.

I put it on the air and found that performance in the fore and aft directions was roughly equivalent to that which I had been getting from a 3.5 foot base-loaded trunk mount antenna. Best of all, I now had no external advertising of the CB in the car. From 20 feet, the small black wire running from the top to the bottom of the windshield is almost impossible to see.

Does it work? You bet. Is the Intenna the answer to everyone's 10 meter or CB needs? Hardly. Does it have any drawbacks? A couple.

The manufacturers of more traditional antennas need have little fear that everyone will throw away his longer antennas in favor of the Intenna. The Intenna will never set any records for long-range communications. It will never take the place of co-phased dual CB antennas for many heavy-duty truckers. But for the guy who only uses his CB on the road talking to other drivers a few hundred yards ahead or behind him, the Intenna is excellent.

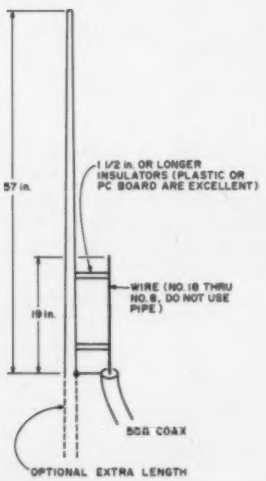
For the person who wants CB or 10 meter communications but doesn't want to let every thief within eyeball distance know about it, the Intenna is well worth considering.

The drawbacks are few, but should also be mentioned. Aside from relatively short range and sharp directivity, the amount of rf energy in the car is a minor problem, particularly when there is a windshield antenna for the car's AM/FM radio.

The energy level is nowhere near high enough to be a health hazard, but it does tend to cause interference on the AM/FM radio when you are listening to music and key the mike. In some cases, you get a feedback squeal; in others, only a squelching of the AM/FM unit. Glyn admits that this is common, but also mentioned that most people turn off one radio when using the other.

The last drawback is that the Intenna should be professionally installed. If your dealer has installation facilities, this is no drawback at all. The Intenna is simple to install, but the tuning is a little critical. However, with the "Mr. Tuner" backup and the well-written instructions, any competent technician should be able to handle the job. In any event, any sale of the Intenna should be topped off by a warning to either have the Intenna professionally installed or to read the instructions very carefully. For example, the instructions state that any other *antenna* installed on the car should be removed before tuning. I found the effect on tuning nil, but the performance of the Intenna is definitely better without another antenna installed. ■

Gene Preston K5GP
906 Cedar Glen
Austin TX 78745


57 in.
1 1/2 in. OR LONGER INSULATORS (PLASTIC OR PC BOARD ARE EXCELLENT)
19 in.
WIRE (NO. 10 THRU NO. 8, DO NOT USE PIPE)
50Ω COAX
OPTIONAL EXTRA LENGTH

The Zeppy Vertical

-- a perfect 2m antenna

Believe it or not, a CBer came up with this antenna. Electrically it looks like a ½ wave endfed Zepp antenna with a ¼ wave section of open wire line to obtain a match to 50 Ohms.

After a couple of days I realized that here was the perfect 2 meter antenna. The main 57" element can be directly bolted to a car frame, be the top of a flagpole, or be a piece of wire directly bolted to the rig. It is better than a 5/8 wave antenna because it doesn't require a ground but has about the same gain.

I built a 57" stinger on a PL-259 plug and found that waving around the mike or touching the radio didn't affect the swr or received signal strength. A 19" piece of wire performed miserably when compared with this antenna. It's also easy to build and easy on the pocketbook. ■

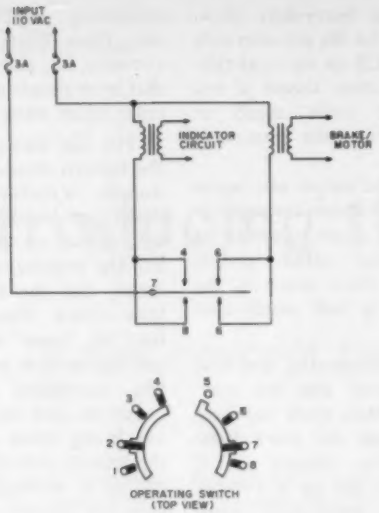


Fig. 1. Original circuit with diagram of operating lever switch as viewed from the top.

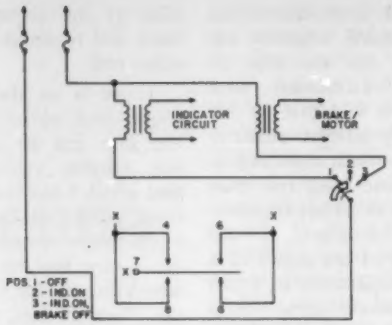


Fig. 2. Modified circuit using 3 position progressive shorting type rotary switch. Original connections are removed from lever switch at points designated by X.

A Cure for Antenna Self-Destruct

-- a mod for your Ham M

Robert H. Johnson W9TKR
505 South Elmwood
Waukegan IL 60085

During the 1971 annual meeting of W9DXCC in Chicago, there was a discussion concerning the problems involved in "instantaneous" braking of antenna arrays. This discussion was quite an eye-opener, and provided much food for thought, and no little worry, as the figures mentioned concerning the stresses involved when a rotating antenna is suddenly brought to an abrupt stop by a mechanical brake were really quite astounding. This sudden strain can be damaging to the rotator, mast, antenna, and not least, the tower itself.

This article will present a simple modification to the Ham M rotor control box which provides manual control of the brake position, and also allows indication of antenna direction, with or without rotation.

All that is needed to complete the modification is a switch and the rerouting of three wires, with no external circuitry outside of the control box required.

The three position switch provides:

1. Off: No primary power to control box.
2. Indicator meter and lights on: Provides continuous indication of antenna direction without rotation, and with brake applied.
3. Brake disengaged, meter and lights on, ready to rotate using normal lever switch.

It must be mentioned here that the transformer which supplies power to the indicator and the lamp circuits is rated for continuous duty, while the transformer which supplies the rotor motor and brake solenoid has a duty cycle of only 10%. This means that it is important that, after watching your antenna coast to a nice smooth stop, you return the switch to position 2 for continuous indication with brake applied, or to position 1, power off. A spring return switch might be useful here, but not absolutely necessary. If you like, a small neon indicator lamp with a 100k series resistor could be wired from position 3 of the added switch to the other side of the ac line to indicate that the brake is disengaged, and to remind you to return the switch to position 1 or 2.

Fig. 1 shows a portion of the original circuit, while Fig. 2 shows the modified circuit, using a rotary three position progressive shorting type switch. Fig. 2(a) is an option, if you prefer using a 2 pole three position rotary. A DPDT toggle switch, with center off position and a long mounting bushing, could also be used.

Modification is done as follows:

Unplug the ac power cord to the control box and remove the multiconductor cable from the terminal board at the rear of the unit. As you remove the conductors from the terminal screws, make a note of the colors and the corresponding terminal numbers, for ease of replacement later.

Remove the screws in the four mounting feet, and lift off the control box cover. Note that there are two blank holes provided just below and to either side of the meter. You will use the right hand hole, viewed from the front.

The switch you use will mount in this hole, and must be small enough to maintain

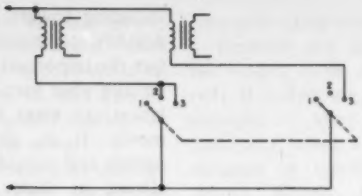


Fig. 2(a). Modified circuit using a 2 pole three position rotary switch.

good clearance between the switch terminals and surrounding metal parts and components. A hole must be drilled in the cover to clear the switch shaft. Be sure to drill this hole in line with the existing hole.

Refer to Fig. 1 for a diagram of the existing lever switch. Remove the wire from terminal 7, and connect to the center arm of the new switch. Remove the wire from terminal 8, and connect to position 2 of the new switch. Remove the wire from terminal 6, and connect to position 3 of the new switch.

That's all there is to it, unless you wish to use the indicator lamp mentioned earlier. You can now watch your antenna coast to a smooth stop, instead of coming to a jarring, metal-shearing, abrupt halt. You will soon learn to anticipate the amount of coast after you release the rotate lever, in order to reach the desired direction. The amount of coast or "gear down" will depend on factors such as the size and weight of your antenna, and the wind velocity.

Remember to switch the brake back on to "stow" the antenna when you are not rotating it. ■

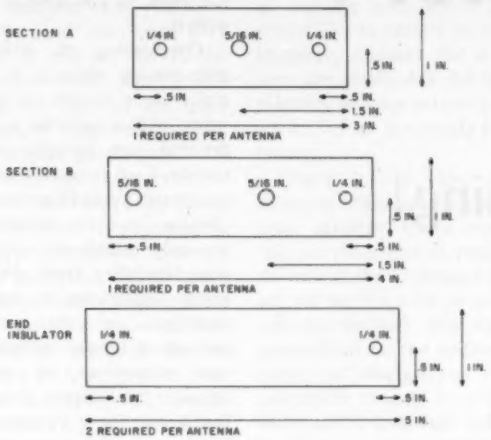


Fig. 1.

Joseph E. Reed WB9JXU
Route 1 Box 24
Mountain WI 54149

Quick Antenna Insulators

-- when DX won't wait

Recently, while I was building antennas, my supply of insulators ran out. As Murphy's Law would have it, none could be found in town. The result was that I could order replacement insulators, overpay, and be delayed several weeks, or I could figure out another alternative. Since I was anxious to get on 20 meter CW as quickly as possible, I decided to build some myself. This resulted in a method for using plexiglas to fabricate insulators quickly and cheaply.

Thanks go to Larry K8ZSQ, who donated a strip of plexiglas 10' x 1" x ¼". The plexiglas was cut and drilled according to the dimensions given in Fig. 1. Sections A and B were joined using epoxy cement. After the epoxy had been allowed to cure, the dipole elements were added and soldered. The RG-58/U was added and joined to the elements beyond the point where the elements joined the center insulator in an effort to reduce strain on this connection and, hopefully, to prevent it from breaking.

Finally, the entire center insulator was weatherproofed with bathtub caulk and taped well.

To date, three such dipole antennas have been built on the HF bands and perform well. ■

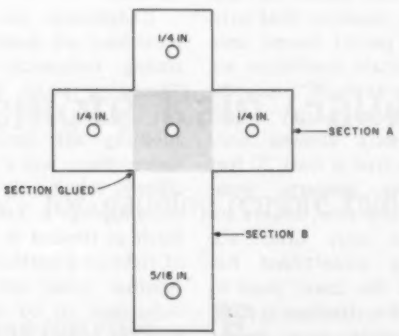


Fig. 2. Completed center insulator.

Fig. 3. Side view showing RG-58/U inserted in the insulator.

Steve Phillabaum WA7URL
505 Vista
Olympia WA 98501

Raising A Tower?

- - don't forget zoning!

As amateurs, most of us have zoning problems only when we try to put up our antennas. While the FCC regulates our indoor activities, local land use controls affect antenna sites outdoors. We have all heard horror stories about former DX chasers reduced to the 2 meter ranks after moving to an area which prohibits towers, or expensive towers staying up only long enough for the neighbors to complain to local officials. Such disasters don't have to occur and, with a little knowledge of zoning, you can avoid similar problems.

Your best opportunity to deal with zoning regulations is when you are moving to a new home. In such cases, you have the opportunity to choose the regulations you would like to live with. The first step is to familiarize yourself with the zoning ordinance for the new area. Visit the local planning department, which is usually located in or near the city hall, and explain your situation. Tell the planner you talk to that you are moving into their jurisdiction and describe your antenna installation to him. The planner should be glad to talk to you; it is always easier for him to explain the regulations to somebody before they have their tower up in the wrong zone. Ask which zones towers are permitted in and where they are not. The planning department will have a map which shows the zoning district boundaries. Look the map over and get an idea where you can locate. You might want to mark a few zoning districts on a city map to take with you when you look for a house.

You will probably find the ordinance treats towers in the following ways, depending on the particular zone in which they are to be located: 1. permits them outright; 2. permits them with conditions; 3. permits them only with a special permit; or 4. prohibits towers.

The first situation is obviously the best. Simply go to the building department, get your building permit (the Uniform Building Code requires a permit for towers or poles), and put up your tower. Don't forget the building permit; it's your insurance policy. If your neighbors complain or the laws are changed, your tower is safe only if you have the permit.

Not many people will have the ideal situation. Most jurisdictions permit towers only when certain conditions are met. For example, I recently moved from a city where towers were allowed only when located at least 20 feet from my property lines. Where I live now, towers are permitted only after the building department has reviewed the tower plans to be sure the structure is safe. Some zones have height limitations on structures, including towers. The list of possible conditions is long, but the important point is to be sure your particular installation can meet the requirements. If so, go get your permit and consider yourself almost as lucky as those whose towers are permitted outright.

The other zones, those where special permits are required or where towers are prohibited, should be avoided. However, I suppose an unfavorable zoning restriction is like TVI; sometimes it's there, so you have to deal with it.

Overcoming an unfavorable zoning obstacle is generally done in one of three ways: with a variance, a conditional use permit, or a rezone. Each remedy is useful for certain types of problems. Usually, variance provisions are only established to provide flexibility from dimensional regulations in special situations. In other words, setback or height restrictions can sometimes be eased through the variance process. Don't ask for a variance to build a tower in a zone where it isn't permitted, because a variance is the wrong tool for that situation (it's like trying to measure current with a voltmeter). If you think you might be a candidate for a variance, ask the planning department if there are special conditions which have to be demonstrated before the variance can be issued. Realistically evaluate the standards and if you still feel you qualify, apply for the variance.

Conditional use permit provisions are sometimes in zoning ordinances for an interesting reason. When the city council first considered adopting the zoning ordinance, there was a group of citizens vehemently opposed to allowing a certain use (such as towers) as a matter of right in a particular zone. Another group was equally outspoken in its desire to have the towers allowed. The council, in its wisdom (it was

probably an election year), didn't want to make either group angry, so they voted to allow towers in that district only after a public hearing for each proposed tower.

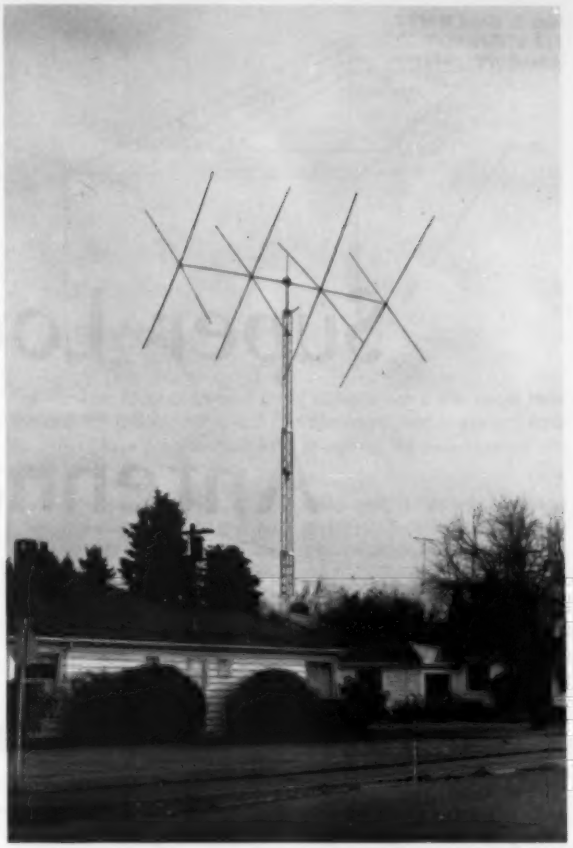
Try to assess your chances for a conditional use permit before you apply. Ask the planners if others have obtained permits in similar situations. Also, look around in the neighborhood for antennas. It may help you obtain a permit if there are other antennas in the same area. Last, talk to the neighbors, explain what you want to do, and see how they react. If you are lucky, the neighbors may sign letters indicating support for your project. If your chances for a permit look good, apply.

Remember, your odds for success are helped by favorable testimony at the hearing and by your ability to design your particular tower installation so that it is compatible with the neighborhood. You should be prepared for the hearing with pictures of your tower and antenna at similar installations. If necessary, offer to keep the tower cranked down behind the garage or to limit the size of the antenna array. If you can anticipate the arguments of those opposed to your tower, you can defuse much negative testimony before it occurs. For example, most neighbors are concerned about possible TVI. Be sure to tell the hearing board early that the FCC regulates and monitors your activities to prevent interference with other services.

Rezones are generally a last resort, to be applied for only if towers are prohibited outright or after you have tried and failed to obtain a variance or conditional use permit. Simply, the object of a rezone is to have your property placed in a different zone, one which permits towers. However, a zone which permits towers may also permit undesirable uses that would prevent the rezone. Generally, unless you are immediately adjacent to an existing zone which you would like to extend to your property, chances for a rezone are small. Ask the local planners or your attorney for advice before you apply for a rezone.

There is one other tool which is often overlooked. If your attempt for a rezone fails, it is sometimes possible to amend the ordinance provisions for the zone in which you are located. Possibly, a prohibition in the ordinance could be changed to a requirement that all towers be less than 50 feet high. Talk to the local planners about the procedures to follow in initiation of a proposed zoning ordinance amendment. Often, it is easier to change the ordinance then it is to obtain a rezone.

There are a few final points to remember. First, zoning regulations are not the only restrictions on land use; often subdivisions have restrictive covenants placed on the lots. These restrictions can be found on file with the county auditor and you should read them carefully, because restrictive covenants can be very powerful and hard to change. Second, if you have found a house you want to buy and don't have time to check the restrictions, you can make an offer subject to the ability to obtain a building permit for your tower and to locate a tower within the subdivision. Last, good luck, and remember that most zoning ordinances are easier to read than you think, especially when compared to the FCC's regulations. ■



The author's recently erected tower and antenna. An inquiring neighbor was told by the local building department, "He has a building permit; it's perfectly legal."

Remote Rain Gauge

- - for gauging remote rain

Richard A. Little K9EEH
407 15th Ave.
Sterling IL 61081

For those of you who have a rain gauge, and would like to know how much rain fell without going out and checking, build this simple indicator for use inside the house.

Drill very small holes at whatever markings you want on your gauge. Use stiff copper wire and epoxy. Use about a 100 Ohm resistor for current limiting to the LEDs.

Make up any type of indicator panel for use inside the house with the LEDs. Label next to each LED the same reading as on the rain gauge so when that light comes on that will be how much rain you have in the rain gauge. ■

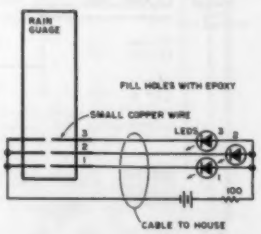


Fig. 1. When the water gets up to the first marking, water will short across wire and turn on LED #1 inside the house.

Wm. E. Hood W2FEZ
116 W. Park St.
Albion NY 14411

Super Loop Antenna

- - great for apartment dwellers

To the urban amateur or apartment dweller, operation on the 80 and 40 meter bands often is out of the question. The main problem is where to put the antenna. Various schemes, some of them ingenious, have been tried with varying degrees of success. Each has had its drawbacks. In preparing a book on amateur antennas, I felt that there was a need for a simple indoor antenna that the average Novice could build economically, that would produce the results needed to encourage the neophyte further into the hobby. The worst problem exists on 80 meters, and it was there that this experiment centered.

After trying numerous configurations, it was decided that a closed loop offered the best hope. Loop antennas are often treated as a specialized class. Little has been written on them, in comparison to the volumes written on other configurations, so little is known of them by the average amateur. Except that they can be a bit tricky to tune, there is no rational reason – it's just a class of antennas that has never been fully explored.

One thing that is known, however, is that a loop can be a very efficient radiator *if* it is properly matched to the transmitter. There is where the big hole is; few loops are matched to their associated equipment, and the consequent poor results quickly discourage the user.

In spite of its apparently large size, the loop described here is in the class known as small loops. A small loop is one in which the total length of the wire used is small compared to a wavelength. Current in a small loop is all in one direction, and is fairly uniform in magnitude. This loop uses a full 130 feet of wire – just ½ wavelength. It is consequently about as big as you can get and still have a small loop.

Small loops behave as large inductors. They can be tuned to any frequency at which they're still small loops with the appropriate capacitor. Their radiation is polarized perpendicular to the plane of the loop, and nearly omnidirectional in the plane of the loop, with virtually no radiation in the directions perpendicular to the plane of the loop. This may seem a contradiction to the next statement because of the polarization. A small loop is considered in engineering circles to be a magnetic dipole. That is, it does with the magnetic component of the wave what a dipole does to the electric component. Being primarily magnetic in its behavior, it is relatively insensitive, when receiving, to lightning and man-made static.

The Super Loop, then, is the largest possible small loop, positioned horizontally, and matched to the transmitter with a simple L network. It is made with common doorbell wire, since it is used indoors. Doorbell wire comes in standard lengths of 65 feet, so two rolls make a nice half-wave antenna. It was wound around the wall of the room near the ceiling, the turns spaced about two inches apart. Where the ends came together, the L network was mounted, and 50 Ohm coax fed down to the equipment.

The L network consisted of a 365 uF "broadcast" variety variable capacitor, one of the few parts still easily obtained, and a 7 microhenry inductor. The inductor was made by winding 24 turns of #18 wire on a scrap of ½ inch PVC pipe, also easy to obtain (½ inch pipe has an *outside* diameter of ¾ inch). When close wound with #18 wire, the length of the winding is 1-1/8 inches. If other wire size is used, it should be space wound to fill the specified

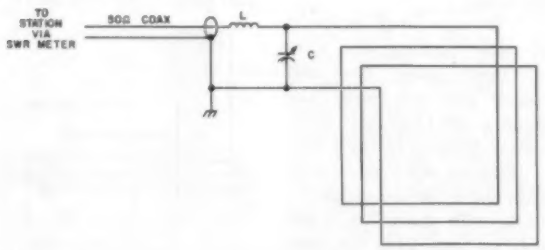


Fig. 1. 130' wound in 3 turns 2" apart. L – 7 uH, 24 turns, 3/4" diameter, 1-1/8" long. C – 365 uF.

length.

The initial tune-up of Super Loop can be a stinker, and a reflected power meter is recommended. Set the antenna tuning capacitor to about 2/3 of its full capacity. With your transmitter set for reduced drive, tune it up as you would a conventional installation. Then set the reduced power meter for swr and tune the antenna capacity for a dip in swr. Finally, repeak the plate tuning capacitor of the transmitter. Because of the relatively small impedance transformation, the output tuning capacitor (sometimes called the load capacitor) of the transmitter can interact considerably with the antenna tuning capacitor. It is here that things can get sticky. The trick is to find that point where the two seem to produce minimum swr. Once that point is found, the loop can be relatively easy to use.

The first experiments with the loop brought almost fantastic results until it was discovered that the loop was proximity-coupling into my outside wire. When the outside wire was taken down, results seemed more rational. Good signal reports were obtained with satisfactory QSOs as far as 1000 miles or more. The worst results came from just over the horizon, which is to be expected, since the loop is a low radiation angle device because of its horizontal position.

Swr averaged around 1.4 throughout the band, thanks to the L network. I have good reason to suspect that the dimensions of the loop have some tolerance, since it has the variable capacitor across it. There being no "ends" in the wire, the so-called end effect does not apply, and the loop dimensions are governed by the wavelength in space. As long as there is a fairly small side-to-end ratio, the form factor isn't too important. Simply adjust it so that the half wavelength of wire makes three full turns.

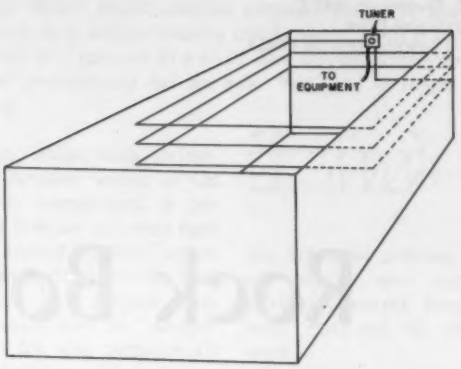


Fig. 2. The loop is wound three times around the room near the ceiling. It's nice if it just fills the room, but it doesn't have to. Also there's no reason why it cannot be mounted on the roof.

I have good reason to suspect that the behavior of the loop will vary somewhat from one location to another, since there is no way of predicting what length of conductor will be within its field to affect it. Nonetheless, based on the reports I've had, I think I might be on to something. The only truly valid test is its use in many different locations, and while I have several amateurs working on loops, it will be quite a while before the results can be fully evaluated. Based on the results to date, I feel it safe to at least offer the amateur world what I've done so far and hope that those who use this antenna will feed back their results. ■

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A14

Karl T. Thurber, Jr. W8FX
372 Crabapple Drive
Wright-Patterson AFB OH 45433

Rock Bottom 2m Antenna

- - uses converted CB components

Surprisingly good results can be had in low power 2 meter mobile work by using a 5/8 wave whip as the radiator rather than the standard ¼ wave whip, as is generally well-known. In practice, I've found that actual on-the-air results are much more favorable to the 5/8 wave whip than the roughly 3.4 dB theoretical gain improvement would suggest, to say the least!

Home brewing a 5/8 wave mobile antenna is a simple proposition, but presents a few mechanical problems as well as occasional difficulty in getting a good match to 52 Ohm coax, so most fellows tend to purchase the antenna as a complete package from one of the major mobile antenna manufacturers. Costing $25-40 or more, these units do an outstanding job of upgrading that mobile signal, but a very professional-looking, good-performing 2 meter antenna can easily be fabricated for a few dollars, particularly if use is made of some low cost CB-type antenna fittings and components.

The antenna described in this article consists of a standard CB-type, "no-holes" trunk lip mount, a modified CB loading coil, and a 47" stainless steel whip. In my case, the entire installation was completed for $11, using a budget-priced CB antenna ($10 at Olson Radio) and a 47" whip obtained for $1 at a local hamfest.

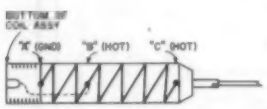


Fig. 1. Point A-B: impedance-matching shunt coil (at dc ground); point B-C: loading coil. Although "hot" for rf, note that the coil is at dc ground, since the shunt, connected to B, is at ground dc potential. Note: "Hot" center pin of coil assembly is factory connected to point B internally.

To modify and install the antenna, first carefully follow the CB antenna manufacturer's instructions for installation of the trunk lip mount. The optimum antenna location (other than roof-mounting) is usually on the forward trunk lid, at the center of the vehicle. The RG-58/U coax can be brought forward through the rear deck to the operating position. Be sure to inspect the coax carefully – some CB antenna manufacturers furnish a very inferior product. If the braid appears thin and the inner conductor can be seen through it, discard the coax and replace it with a 16-18 foot length of high quality RG-58/U. Also, ensure that the set screws in the mount make a good dc contact with the trunk lip, and that the coax isn't pinched as it emerges from the mount. Check the mount and coax for continuity and shorting.

Next, discard the short CB whip furnished with the antenna package. (In the case of the Pace CB antenna I used, the very short 34" whip included was cut down to 19" to make a ¼ wave handie-talkie antenna for improved performance over the usual "rubber ducky," or it can be base loaded to form a ½ wave HT whip as described by K3VNR in July's *73 Magazine*.)

In any case, replace the short CB-type whip with a 47" stainless steel whip of the type usually available for a dollar or so at hamfests, flea markets, and various surplus outlets. Be sure to obtain a whip that will slip into the stud provided with the CB antenna; a collapsible rigid whip is not recommended.

The next step is to disassemble the loading coil. When the plastic cover is slid off, you will find two coil windings, a small shunt-wound impedance-matching portion at the base, and a dozen or so turns of #14-16 wire which constitutes the loading coil proper, as shown in Fig. 1. Both windings must be removed. Once this is done, wind five (5) turns of #14 or #16 PE wire around the coil form between points "B" and "C" as shown in Fig. 2. An impedance-matching shunt coil isn't required for the 2 meter antenna.

The antenna is tuned using a good VHF-type swr bridge at the transceiver, adjusting the coil spacing slightly and/or the antenna length using the set screw adjustment in the stud at the top of the loading coil. In my case, 5 minutes worth of simple "tweaking" adjustments produced a very nearly "flat" 1:1 vswr over 146-148 MHz. Once adjustment is completed, the plastic coil cover can be slid into place, swr rechecked, and the coil cover cemented and sealed for weather protection.

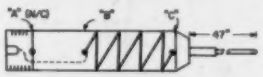
At W8FX/m, the inexpensive Pace CB antenna kit used did not use a spring;

actually, a spring is unnecessary and may in fact cause some radiation efficiency loss at 2 meters if used. However, the installation could be varied to include the spring and, if the CB whip used were a relatively long one (some are 39-41"), the added spring length could obviate the need for acquiring a new whip. If a spring and slightly shorter whip are used, then some experimentation with the number of loading coil turns would be required (try 7 turns for starters).

This article points out a specific mobile antenna design, but it also serves to highlight the "gold mine" of antenna fittings and parts which have been mass-produced for the CBer but which can, with some ingenuity, be readily "appropriated" for ham use. Similar construction possibilities exist with respect to 10, 6, 1¼, and ¾ meter antennas. For example, a turn or two off the original CB coil will resonate the antenna nicely within the 10 meter band; a few turns on a cannibalized loading coil will turn the same 47" whip into a dandy ¼ wave 6 meter mobile antenna, merely requiring interchange of the loading coil itself. And, a mag-mount, mirror mount, or gutter clip-on might be just right for your van or VW installation instead of the trunk lid mount. But consider that the overall effectiveness of the antenna depends to a great extent on getting a good ground to the auto body and getting a good, fairly symmetrical ground plane under the antenna. For these reasons I'm leery of using these other types of mounts.

A real boost for this kind of project comes from the fact that mobile CB antenna kits are now available in discount stores for as little as $10-15, making cannibalization painless, and both Olson and Radio Shack (among other distributors) are now selling individual replacement CB antenna parts (coils, mounts, whips, studs, springs, etc.). Another source of CB antenna components is the local CB dealer who may have lying around "junked" antenna coils, springs, mounts, etc., available at a bargain price, and which may be "rehabilitated" for your purposes. Of course, if you already have a CB mount installed, and who doesn't these days, all that is required for this 2 meter antenna is an extra coil and 47" whip.

Fig. 2. Note: Shunt winding between points A and B is removed, as is original loading coil between points B and C. A new coil of 5 turns of #14-16 PE wire is substituted from B to C. Coil and antenna rod are now "hot" and no longer at dc ground.



As with any antenna project, the "proof is in the working," and work it does. I use this antenna with a Wilson HT at 2.5 Watts output, consistently working several Dayton area and out-of-town repeaters out to distances of 40-50 miles. Side-by-side comparisons using a ¼ wave whip on the same vehicle invariably favor the 5/8 wave antenna, both on receive and transmit. Gratifying results have also been obtained in simplex work.

In addition, the installation has, as a bonus, the feature that fittings are compatible with regular CB antennas; at W8FX, the same mount doubles as a base for the ol' CB antenna, with a 2 position coax switch on the dash switching the antenna lead from the 2 meter rig to the CB set. Future plans call for making similar interchangeable antennas for 6 and 1¼ meters, using the same mount and coax lead-in.

Who says CB hasn't produced some good side benefits for hams? ■

Ken Schnell W5OBR
2607 Easy St.
Pasadena TX 77502

Antenna Gain Facts

-- don't be misled

This will be a short article to discuss the gain of antennas. I always get confused when someone quotes me a gain of a particular antenna. The confusion arises because I don't know what baseline or reference point he is using. Normally, in measuring HF antenna gain, the figures are referenced to those obtained by using a horizontal dipole (halfwave). In the FM communications field, the reference for gain is still a halfwave dipole, but mounted in the vertical plane. As far as the FCC rules are concerned, antenna gain is based on a halfwave dipole as a reference. This can be important because many antenna manufacturers use an isotropic source as a reference for listing the gain of their antennas. A common antenna (and the simplest) is the 1/4 wavelength whip perpendicular to ground plane. By comparison to an isotropic source, this antenna shows a gain of .3 dB. Additionally, the 1/2 wavelength antenna shows a gain of 2.1 dB over isotropic or 1.8 dB gain over a 1/4 wavelength antenna. The common 5/8 wavelength antenna, that we see so often on the mobiles, has a gain of 1.2 dB over the 1/2 wavelength or 3.3 dB over isotropic. Higher omnidirectional gain is usually accomplished by using stacked halfwave dipoles. As an example, four stacked halfwave dipoles on 146 MHz can provide approximately 6 dB gain. Usually the maximum number of halfwave elements stacked vertically will be eight (8), which should provide an omnidirectional gain of about 9 dB. ■

Antenna Type	Gain
Isotropic	.0
1/4 wave	.3
1/2 wave	2.1
5/8 wave	3.3
Collinear	6.0

The 8JK Array Revisited

-- inexpensive and effective

Tim Soxman W3ZVT/4
P.O. Box 375
Shaw AFB SC 29152

Being an antenna nut and cheap also makes one look for inexpensive and effective antennas capable of getting the most out of the rig. A good example of such an antenna is the "8JK". Various articles in the past have treated this type of antenna as a rotary beam on the higher bands (20, 15, and 10), but very little material has been available for the lower frequencies. Since the estimated gain of such an antenna is 3-4 dB, it becomes an attractive alternate to running higher power. I shall attempt to examine various configurations of such an antenna and provide some insight into possible uses. The *ARRL Antenna Handbook* devotes some space to the 8JK (p. 207). The spacing outlined in the handbook is .1 wavelength, which in the case of the handbook antenna is used to reduce the antenna feedpoint resistance. It should also be noted that the radiating elements are cut as a driven element/reflector combination. This may be fine when such an array can be rotated, but the idea of building such an antenna for the lower bands soon leads to problems. The thing that isn't too readily realized is that the directivity of such an antenna, if both radiating elements are of equal length, is governed primarily by the antenna feed phasing. When this premise is understood, one can then see that a 3-4 dB 80 or 40 meter bidirectional beam can be readily constructed. See Fig. 1.

The thought of sinking four poles and cluttering up the landscape probably won't enchant too many people, so let's look at a less painful way of achieving the same result. How about just two poles (trees, etc.)? Okay, how about a bidirectional inverted V beam? Would you believe just two 30 foot poles? The normal inverted V with a 90° apex angle has predominantly a vertical angle of radiation, so let's use a 120° apex angle to enhance the horizontal radiation characteristic. On 80 meters, this means the support for the antenna apex will be approximately 30 feet tall. This would be easily handled by TV masting, since the antenna elements can be used as guys. See Fig. 2.

The inverted V arrangement also provides a plus in that trimming of the antenna to resonance is facilitated due to the accessibility of the element ends.

The key to this antenna is the transposition box. This little jewel provides the necessary phasing line transposition to change the directivity

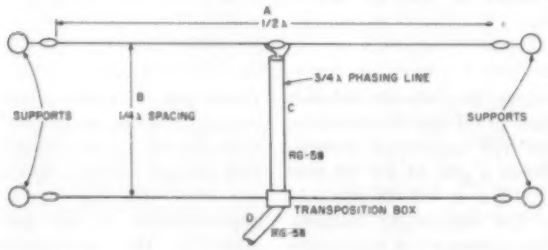


*Fig. 1. A = 468/fMHz; B = 234/fMHz; C = (702/fMHz)(V); D = (468/fMHz)(V). V = line velocity factor. Values for a 3.9 MHz: A = 120'; B = 60'; *C = 118.8'; *D = 79.2'. *Based on a .66 velocity factor.*

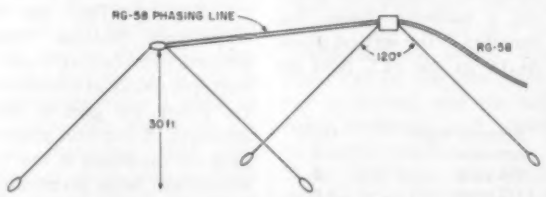


Fig. 2.

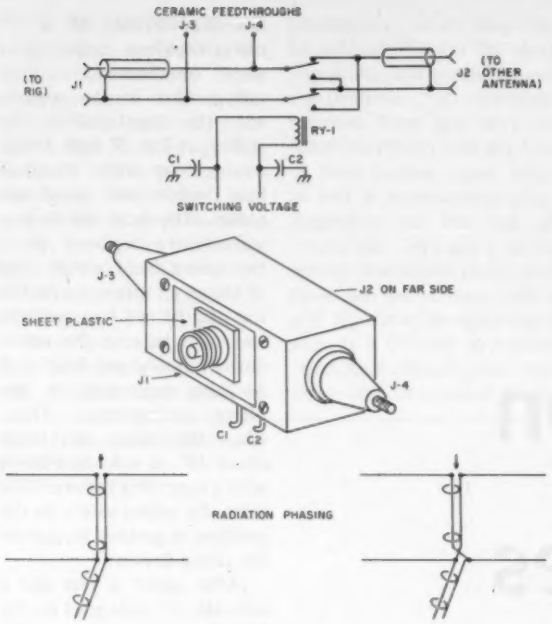


Fig. 3. RY-1 — latching relay; C1, C2 — .001 uF feedthrough. Note: J1 and J2 must be mounted on insulated bracket or plastic wall in minibox.

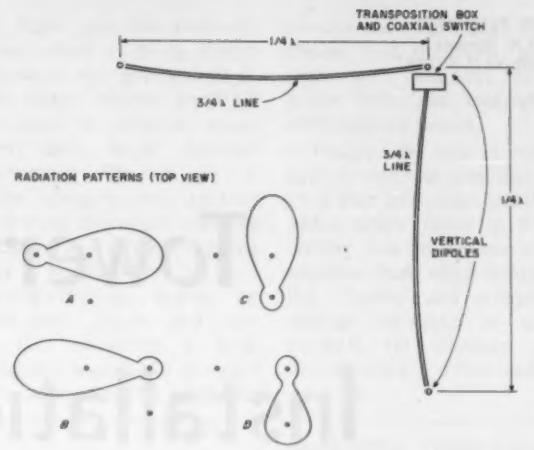


Fig. 4.

of the beam. Fig. 3 details the construction and wiring of the box.

The dimensions outlined are for 75 meters, but may be adjusted for other bands. The antenna feedline should be in multiples of an electrical half wave (don't forget the velocity factor). The 3/4 wave phasing line length must be computed using the same techniques.

The same approach may be used vertically with line transposition providing the directional capability. Of course, if you really want to get wild, the addition of a coaxial relay and an additional antenna along with its attendant 3/4 wave phasing line will enable you to punch up 3-4 dB gain in the north/south or east/west directions. See Fig. 4. ■

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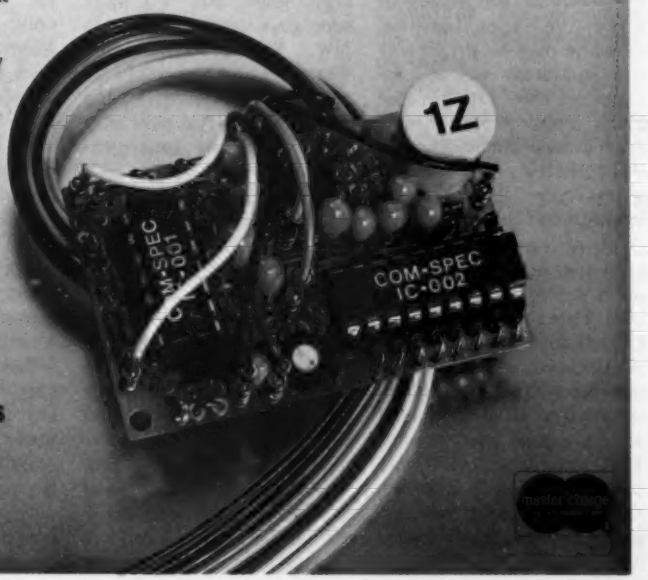

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Tower Installation Techniques

-- using rope guys !

Many self-supported towers and beam antennas are blown over and lost each year unnecessarily, causing insurance rates to escalate for all tower owners. Those who lose towers are frequently at fault because of excessive top loading, excessive mast height, or lack of indicated guying. Inexpensive rope guys can save costly replacement of towers and beams in almost all cases, and it is very satisfying to be worry-free during windstorms.

Many years ago a guy wire untwisted at an egg insulator on a rooftop tower, and a new Telrex beam was lost when it dove into an oak tree. A 60' Easy-Way tower, crank-up, tilt-over type, was installed next at ground level with a ground post support. The tower seemed rather flimsy to hold a beam without guying, so at the suggestion of another amateur, WB4QPH, who already had a similar tower, ¼" polypropylene rope, from Sears mail order, was installed in six directions at the top of the tower.

These original rope guys are still in service after about eight years, but two more rope guys were added in the NW, W, and SW wind directions and one additional guy added in the NE, E, and SE. The additional guys were added after the tower was nearly lost when a guy rope was inadvertently cut at the rotator mounting plate during a windstorm. Also, the tower was increased to 70 feet when an Easy-Way top section and a 10/15 Duobander beam were added, a tribander beam was changed to a 204BA monobander, and a 2 meter 8 element beam was added on top of the mast.

The top section, including the 10 foot extension, was bent roughly 15°, just above the second section, when the rope guy was cut at the rotator plate. The top section could not be lowered, and there was no room to tilt the tower over because of trees. However, it was possible to lower the second section inside the lowest section, so the bent tower point was only about 20 feet above ground. All of the guy ropes were brought around to the proper position, and the tower was carefully brought back to plumb after several sitings vertically along the tower. The top section could then be lowered and still is in use. This shows that with guy ropes, a tower can be straightened sometimes, without dismantling. But extra guy ropes should be immediately installed.

A few years later, a 100' Heights tilt-over aluminum tower was obtained from an amateur who moved away. While this tower was of heavy duty construction, with the topmost section spaced wider than the lowest section of the Easy-Way tower, six x ½" polypropylene rope guys were installed for added safety. One of the reasons was the questionable reliability of the 5' high tilting arrangement with its small boat winch and quadruple pulley. The boat winch was immediately replaced by a two speed Gold winch. One of the guy ropes was over the top of a 70' oak tree, and this was used to ease the tower down initially and hold it if anything happened to the tilting arrangement. Then, when the tower was tilted about 45°, it was eased down with a rope sling between two trees, for added safety in the position of greatest torque on the tilting device.

After about a year and a half, the ½" rope guys on the 100 foot tower completely disintegrated, probably from the sun's rays. However, a full refund was obtained from Sears when the ropes were returned. These polypropylene ropes had blue and yellow strands, while the original ropes, still in use, have black and white strands. It was then urgent to obtain new guy rope because I was in the midst of the 80 meter part of 5BDXCC on two-way SSB. A heavy 80 meter beam was on the 100' tower, consisting of tunable 80 meter cliffdweller driven elements, spaced 32'.

Fortunately, through a nautically inclined amateur, WA9NUQ, I obtained a catalog from West Products, 161 Prescott St., East Boston MA 02128. This firm offered a utility grade ¼" nylon rope at a very reasonable price, and I ordered 2000 feet, with an explanation of the intended use. The order was quickly filled as requested, but with ¼" Dacron rope, at only slightly increased cost, and the suggestion that this was much better for the application. In view of the increased rating and less stretching of this rope, I installed only 6 guy ropes on the 100' tower, along with pulleys for various antennas

on the 70' and 100' towers.

Since then, two other amateurs have benefitted from the extra rope I ordered. We are all very satisfied with Dacron rope for tower guying because it is stronger, has less stretch, the knots don't slip as with polypropylene, and, finally, it is softer and much easier on the hands. It can be coiled up without gloves, when a tower is dropped.

There are several advantages with rope guys, other than keeping towers up in windstorms, which may not be realized. Perhaps the most important, and possibly most controversial, is complete freedom from guy wire reradiation effects and any loss of front-to-back signal ratio, as well as front-to-side ratio. Regardless of the use of insulators in guy wires, various resonances occur, and these can be verified with a grid dip meter along each guy wire. It is difficult to prevent reradiation effects from guy wires over all amateur bands.

Rope guys also eliminate even closer coupling effects between wire guys and 40 or 80 meter "slopper dipoles," inverted V antennas, quads and delta loops. Another advantage with rope guys is the protection against lightning discharges following down a guy wire and jumping to a house. Recently, in a neighboring town, an amateur's house and contents, including a large station, were badly damaged by a fire caused by a guy wire conducted lightning discharge. And, of course, guy wires are hazardous near power lines, and especially with crank-up towers.

Finally, the cost of rope guys is minimal considering all of their advantages and the added safety factor in preventing loss of towers and antennas from wind damage. But liability and property damage insurance is still needed for coverage of unexpected, catastrophic losses. ■

James T. Martino WB8MSV
4713 Booth Rd.
Oxford OH 45056

An Ultimate Invisible Antenna

-- works well when it's not raining

The arrival of the first transmitter at the home QTH raised two problems. How would the neighbors react? How does one get an antenna away from trees? The trees were too close together for a dipole on 80 meters and too tall for an inverted vee anywhere near the transmitter. As a joke, one student suggested using the downspout and gutter.

From 1972 through 1976 this was the only antenna I used. It put out enough signal to work both coasts on 40 meters and work several foreign countries on other bands with a very limited home operating schedule.

The antenna is quite simple. The gutter is nailed to the eaves of the house in the normal manner. A drainspout runs down the side of the house from the eave trough to a tile in the ground. The drainspout was cut off just above the tile and a hole drilled in it for a self-tapping metal screw. A single feed wire was run from the rig in the basement to the downspout and was attached with the self-tapping screw. As a Novice, I was limited to 75 Watts. Fortunately, feeding the wire directly from an SB-102 resulted in no ill effects to the finals. The move up to Advanced allowed me more power, so I used a home brew ultimate transmatch to lower the swr.

At the present cost of parts for a transmatch, the beginning ham might use a tuned feeder. Tuning is done by taking a long piece of wire (maybe 10 feet more than necessary) and cutting short sections off the wire until the antenna loads on the desired band with a low swr. If more than one band is desired, another lead-in wire can be used. One lead wire may be necessary for each band desired, but sometimes one is lucky, and one lead-in might serve 2 or more bands. The lead-in wire used here is solid copper insulated wire.

Allband operation can be achieved by using tuned feeders for each desired band and connecting them to the output of a rotary switch. The transmitter is connected to the switch (which should be in a well grounded metal box) by a piece of coaxial cable. The operator selects the band simply by moving the switch.

I took the time and effort to tune a feeder for 40 meters and have an swr of 1:1 at 7.15 MHz and an swr of 3:1 at the band edge.

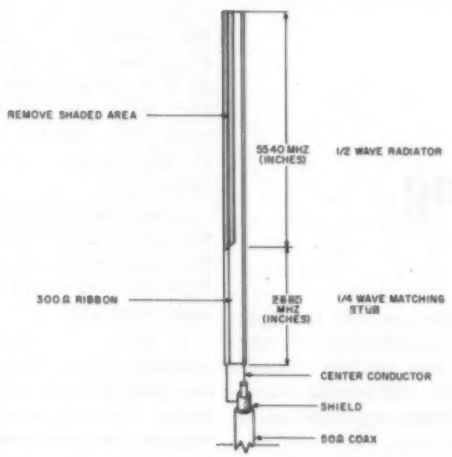
I have a continuous aluminum gutter and have not tried this on a gutter made in sections. The sections may cause some TVI, but there has been no problem here except on channels 2 and 5. My well-tuned dipoles cause the same amount of problem. The transmitter should be well grounded when using this antenna. Otherwise, rf builds up on the case and can lead to serious shocks. ■

Mountaintop Special Antenna

-- fits in a backpack

C. O. Klawitter W9VZR
4627 North Bartlett Avenue
Milwaukee WI 53211

If you like to camp, mountaintop, operate portable on vacation, participate in Field Day activities, or possibly need a quick temporary antenna at a new location, the antenna described in this article will be just what you are looking for. Although this antenna was designed for ten meters, it can easily be adapted for six and two meter use by adjusting the length according to the table which accompanies the diagram.



J-pole antenna.

The antenna is the good old standby — the J-pole. It was selected because it has a half wave radiator, nice low angle of radiation, could be constructed of inexpensive 300 Ohm ribbon, has its own simple, built-in quarter wave matching stub, can be directly fed with 50 Ohm coax, has a low vswr over a large bandwidth, and can be rolled up into a light small package. How can you go wrong with all those advantages? It's almost like perpetual motion.

The diagram shows its general construction. Use either a knife or heavy shears to split or cut the 300 Ohm ribbon down to the matching stub, and then carefully remove the unwanted portion. The coax is simply soldered to the end of the 300 Ohm ribbon, weatherproofed with a plastic spray, and then wrapped with black plastic tape for additional weatherproofing and strength. RG-58/U cable was used to keep down the weight and should be satisfactory for lengths of thirty feet or less. The top end of the matching stub and the half wave radiator were also sprayed and taped. To mount the antenna, I tape twenty-five feet of nylon rope onto the end of the antenna. A nylon cord could be passed through the dielectric at the top of the antenna for its suspension.

When trees are available, tie a rock around the rope and use a strong arm to get the antenna mounted. This may take a little practice. From personal experience, I would make these suggestions: Watch out for windows, wear a football helmet, make the points on the antenna where you have added tape as smooth as possible, and try to stay a quarter wavelength away from large pieces of metal. I think those suggestions are self-explanatory. Even after I had taken all of these precautions, the rock came loose from the rope, fell on the 300 Ohm ribbon, and cut the antenna in half.

Well, I still think it is a good idea, and it has proved successful. I have also included a table determining the antenna length for those of us who flunked fifth grade math. ■

Frequency (MHz)	28.0	28.5	29.0	50.0	51.0	52.0	144	145	146	147
Radiator (inches)										
½ wave	197.8	194.3	191.0	110.8	108.6	106.5	38.4	38.2	37.9	37.7
Stub (inches)										
¼ wave	102.8	101.0	99.3	57.6	56.4	55.3	20.0	19.8	19.7	19.6

Table 1. Antenna length.

Rick Ferranti WA6NCX/1
14 Divinity Ave. #17
Cambridge MA 02138

Fiery Endfed

-- keep antennas ice-free!

The winter of 1977, so I've been told, was the worst in over 100 years, at least for the Midwest and the East Coast. Coming from California where the weather is always warm, I was led to think that the simple endfed random length wire was the ideal solution to the problems of operating in a dorm room or apartment. But moving out to the snowy, icy chill of New England left my ideals in a frozen heap of wired snow, collapsed ignobly on the ground. The results were a badly mismatched transmitter and disastrous signal reports.

Every place in which I've had the fortune to dwell always has had at least one window looking out toward a tree, pole, or other building. With a little bit of nighttime or early morning rock-throwing, arrow shooting, or flycasting, I've been able to secure a nylon line to that remote support. Then, a wire is slinked out, made fast, and a primitive but effective matching network employed to fool my poor FT-101B into thinking that a 37 foot piece of copper is a 50 Ohm dummy load.

This works great until you find out that snow, a funny white stuff which apparently falls freely all winter everywhere except California, is made out of water. Water weighs over 8 pounds per gallon – it doesn't take much snow to accumulate on a skinny piece of wire and make it *very* heavy. After a particularly nasty storm blew its way into Boston in our wonderful winter of '77, guess what happened? My lovely wire antenna snapped under its unwanted icy-white burden, leaving the transceiver in grave doubts as to whether its pi-network would ever be duped again by coils, capacitors and random copper.

There are three solutions to this problem. One is to move back to California as any sane person would do. However, in my case at least, the phenomenon known as graduate school prevents me from being counted among the sane. The second is to do what the power company, Ma Bell and the rapid transit people do – use enormously thick and strong cables with reinforced supports so that even if the frozen Charles River were encased around the wire, it wouldn't give a bit. But thick copper wire can get very expensive and cumbersome and also violates the ideal of having as invisible an antenna as possible, so that the RFI complaints get directed elsewhere.

The third way is to take advantage of the slightly higher resistance of thin copper wires over the big fat ones. I ran a twisted pair of #24 insulated wires out to my support with the ends soldered together at the far end. When I use the twisted pair as an antenna, I merely connect the two ends together at my end and feed the whole mess as a single wire. But come the ires of Mother Nature and buildup of ice on the line, I disconnect and separate the two wires at my end and feed some current (dc or 60 cycle, not rf) into the resultant loop to make it toasty warm. The ice melts, and the strain is off the antenna. This heated antenna idea really does work. All you need is a variac and a hefty filament transformer (whatever is handy), and you can power the thing up. Once the ice is off, relatively little current (wires not even warm to the touch) is needed to keep the antenna clean of white stuff.

Use a copper wire table to determine the resistance of the wire and be sure to double the figure for the measured length of the antenna, since it's a loop out and back. Don't get carried away with the heating juice, or you'll burn up your snowbound antenna and really be the victim of fiery irony!

Some excessively clever soul will no doubt come up with a tension-actuated switch which would automatically disconnect the antenna, separate the two ends of the loop, and feed in the heating current once the pull of the line increases with snow buildup.

The light weight of the #24 twisted pair and its ability to shrug off snow at the turn of the knob result in an antenna which is durable and resistant to wind and storms. It even serves to radiate rf power quite effectively from its associated transmitter, heating up the ether and, on occasion, the coldest winter in a long time. ■

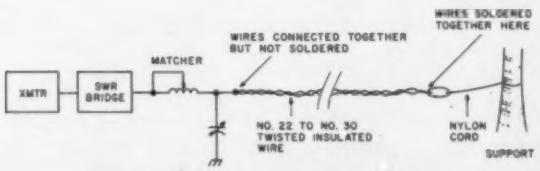


Fig. 1. Fiery endfed antenna in normal use.

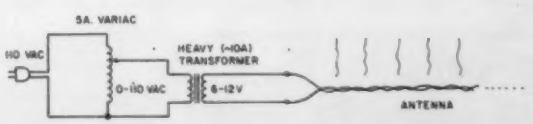


Fig. 2. Heating the antenna when things get icy.

Karl T. Thurber, Jr. W8FX
372 Crabapple Dr.
Wright-Patterson AFB OH 45433

Build A Vacation Special

-- portable antenna systems

Frequent moves and periods of extended travel associated with Air Force duty bring to focus the need for a compact combination receiving antenna and rf preamplifier system.

The circuit shown in Fig. 1 combines the requirements of compactness, portability, and low cost in a unit that can be built for roughly $10-$15, using mostly junk box parts. The unit, housed in an attractive aluminum and gray mini-cabinet, makes a handsome and very professional-appearing adjunct to any general coverage receiver.

Transistors Q1 and Q2 may be substituted for. If an RCA 40468 FET is substituted for Q1, a fourth lead (a shield wire) will be found coming from the body of the transistor. This should be connected to ground. Other component values are not critical. The three mini-toggles are relatively expensive, but often can be found at local surplus outlets or at swapfests for as little as 35¢. The 47" stainless steel whip was obtained at a local ham-fest for a dollar.

Though solid state, the unit is probably most easily constructed using conventional wiring techniques, using the switches and a couple of multiple terminal strips as convenient mounting points. Most of the components are mounted in the area formed by the "U" shape of the lower portions of the mini-box. The rf input coil and tap selector switch are conveniently mounted on top of the cabinet, as is the type F, BNC or SO-239 chassis mount antenna connector – use whichever type you prefer.

The whip selected can be inserted into the cable connector selected and epoxied into it – at W8FX, type F connectors are used, so that the 47" whip doubles as a 5/8 wave 2 meter antenna for high performance work with a Wilson handie-talkie.

A single pole, 20 position rotary switch is used to select the optimum tap on the input coil. While a switch having fewer or more positions could be substituted, the 20 available tap positions allow good continuous coverage with the 47" whip from 160 to 10 meters, including the SWL and utility bands in between. The coil is wound on a 1/2" wooden dowel with about 150 turns of #28 PE magnet wire, tapped at 3, 7, 12, 18, 25, and then about every 10-11 turns. After connection to the rotary selector switch, the coil can be epoxied into place.

A short length of RG-58C/U coax terminated in a PL-259 connects the unit to the receiver. The only internal adjustment required is setting the optimum value of R1, the 2k Ohm potentiometer. This is done by turning the unit on, peaking the antenna switch for maximum received signal strength, and then peaking R1 for maximum gain. Check all bands to see if any oscillation is encountered – if so, back off R1 slightly until it

disappears. The setting of R1 can then be left alone.

L1, C1, and C2 form a pi network input circuit, while S1 allows the capacitors to be switched out of the circuit if desired. (C1 and C2 are not strictly necessary and may be omitted if desired, with little performance degradation. S1 would then be omitted.)

Transistor Q1 is a MOSFET type with very high gain, which is protected against excessive gate voltage caused by nearby transmitters; Q2 serves as an emitter follower to match the medium output of the MOSFET (Q1) to the low input impedance of most receivers.

One caution in construction is to exercise care in the handling of Q1. Its gate is quite sensitive to static charges, and therefore it should be handled with a short circuit across its leads until just before power is applied to the circuit. Also, don't apply a soldering iron to Q1's leads unless they are shorted to one another.

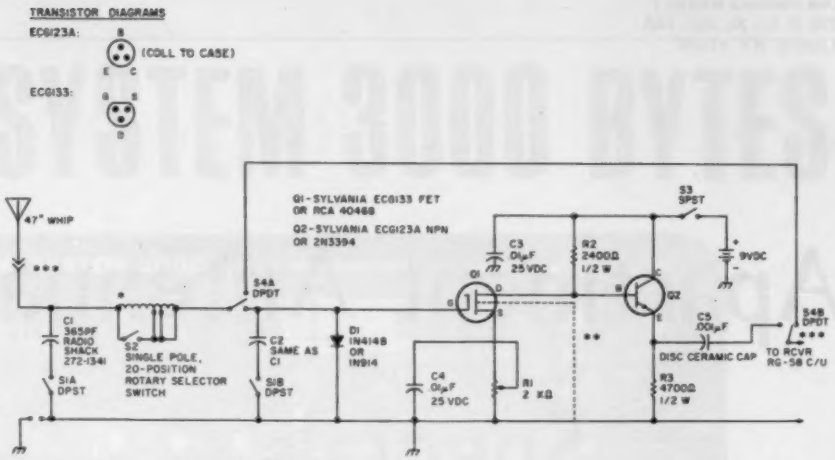
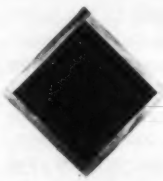


*Fig. 1. *150 turns #28 PE (see text). **Shield wire if RCA 40468 is used. ***See text for type connectors.*

A standard 9 volt transistor radio battery powers the preamp. A source of 9-12 V dc could be obtained from the receiver, but current drain is so small that this is unnecessary.

The overall result is a super sensitive, versatile receiving system featuring an overall gain of more than 30 dB. It has been used with good results on several communications receivers, such as the Yaesu FRG-7 and Allied/Radio Shack SX-190. In fact, results seem to equal those obtained from the 20-50 foot random wire usually strung out for casual portable listening. Of course, the unit can double as an allband preamp used in conjunction with the regular station antenna, although cross modulation and overloading effects may be troublesome unless an rf attenuator is used ahead of the FET input. ■



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Apartment Antenna Specials

-- next, hide your Mod 19

All you apartment dwellers – get ready. Here are a bunch of ideas for how to hide antennas, run cables and set up a shack. (The nosy body on the fifth floor will never know you're there.)

The biggest problem for apartment dwellers is usually how to put up an antenna. Actually, we apartment owners have it made – in my case I have an antenna height of 190 feet. Not bad, eh?

To start off, if you have access to the roof, that's great! But, of course, we all know that most apartment owners are not even allowed to put any protruding objects outside of their windows. "Protruding objects" means antennas. One of the best ideas for an apartment owner is a long wire or dipole. With that there's only one problem – how to put it up. Stringing the antenna between two buildings would be ideal. If that's not possible, the next best thing, and probably most common, is a wire antenna strung along the apartment windows. To start with, there is absolutely no way you can have an apartment shack without a transmatch.

When you are putting an antenna up try to keep the antenna from touching the building. If this happens chances are it will short out. Also, always get as much wire out as possible. Use the thinnest, most durable and least likely to be seen wire that you can find. If possible, paint the wire the same color as the building. Try to get the antenna at least four or more feet away from any obstructions. Any antenna you can get outside is better than an antenna inside. Don't let the antenna dangle; always pull it tight.

One of the best ways I know of to support the antenna is to put 1" x 1" x 4' strips of wood on the window. Put screw eyes in these strips to attach the antenna to, but don't tie the antenna directly to the screw eye. There should be an insulator between the antenna and the screw eye. Galvanized wire going from the tip of the strip to the top of the window helps to support the antenna. Don't hesitate to pay for a good support. A well constructed antenna won't come down until you take it down.

Now, I have a word to say about coax. Try to keep coax runs shorter than 15 to 20 feet. If you must make a run longer than this use RG-8/U. Usually when you string an antenna around an apartment you use RG-58/U since it is much more flexible than 8/U. If you have to go around corners with coax, use 58/U and try as much as possible not to put sharp bends in it.

If you are putting up a dipole, have the coax come straight out of the bottom of the antenna. Try to insulate the center of the dipole. (A Plexiglas™ block is ideal for this purpose.)

Let's get off the subject of antennas before we get dizzy from the height. A lot of people ask how to get a good ground in an apartment. To tell the truth there is no really good ground. The best thing to use if you can't knock a ground rod a couple of feet into the ground is a water pipe. If your shack isn't in the bathroom then you probably don't have a handy water pipe. The next best thing is a radiator pipe. For a good connection to the pipe, scrape away all the paint. The best thing to use to connect the wire to the pipe is a hose clamp.

When you set up your shack always try to put up shelves above the desk. Try also to get all your equipment within reach without having to get up. Standard connectors throughout the shack are absolutely necessary. Don't bolt your paddles or key directly to the desk. And, as for a desk, just about anything will do except a collapsible table. They usually can't hold the weight.

Your shack should be close to a window and water pipe of some kind. Try not to have your entire shack plugged into one outlet or ... "Standby OM, the circuit breaker just went!" Don't put any wires under carpets. Don't even think about not getting lightning protection devices. When possible try to keep your power output as low as possible.

At all times do everything in your power to prevent TVI. The fewer people who know you're a ham, the fewer people there are to blame you for TVI. Stay away from 6 meters.

To sum it all up, it isn't so bad living in an apartment. Just try to use every bit of space you have. I hope you are able to use some of these ideas to help you put up a better antenna and enjoy amateur radio. And, if you have any ideas or inventions for apartment dwellers, please send them to me. ■

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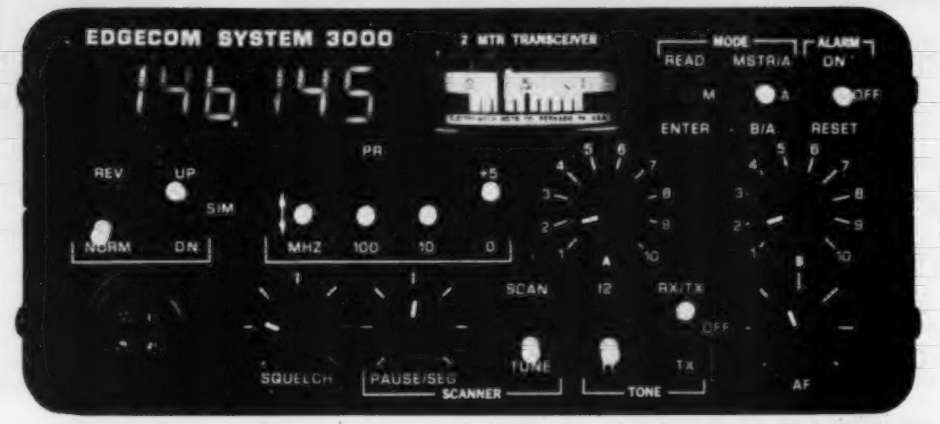

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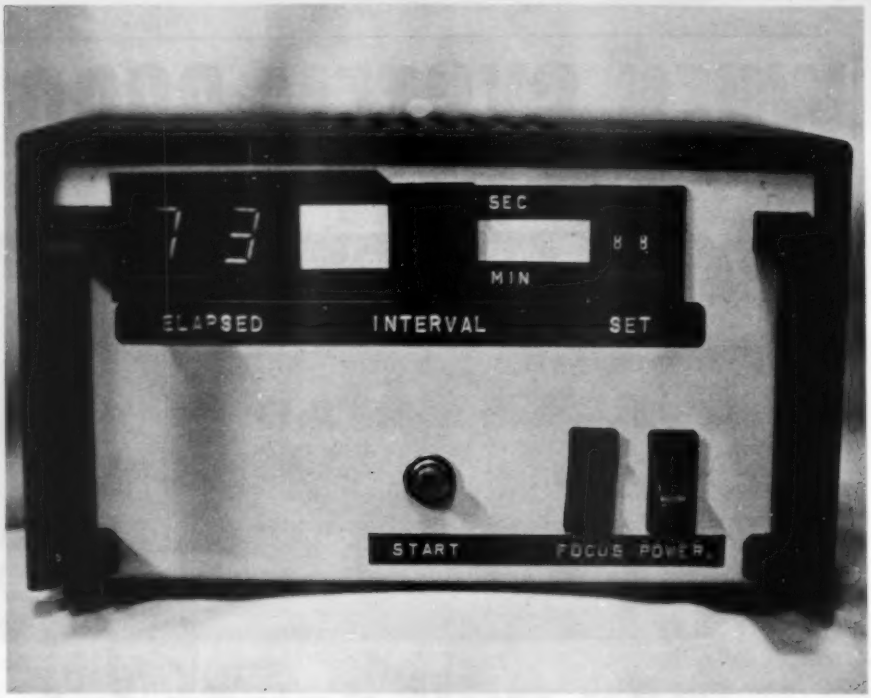
Front view of unit.



Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

Build A Unique Timer

-- for the ham photographer

The need for electronic timers must be ubiquitous. One certainly gets this impression from the number of timer articles published in the various electronic magazines. There are repeater timers, identification timers, phone call timers, Polaroid timers, and egg timers. One even suspects there are timers that are intended for uses which could not be discussed in a family magazine. Many have been suggested for photographic work; however, each of these has certain defects which prevent it from being an ideal enlarging timer. The ideal timer for darkroom use must accomplish several tasks:

1. Timing in seconds to at least one minute for routine exposures;
2. Timing in minutes to at least 15 minutes for mural or special work;
3. A rapid, foolproof way of entering time interval desired;
4. Indication that the time cycle is progressing, and elapsed time;
5. Automatically extinguish safelight when enlarger is on;
6. Allow for "focus" or non-timed on state;
7. Allow interval to be interrupted for "burn-

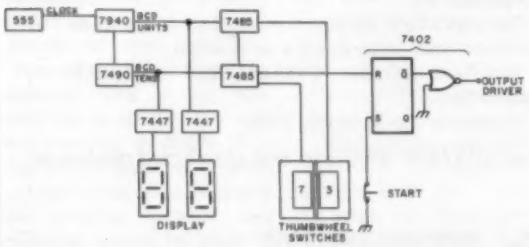


Fig. 1. Block diagram.

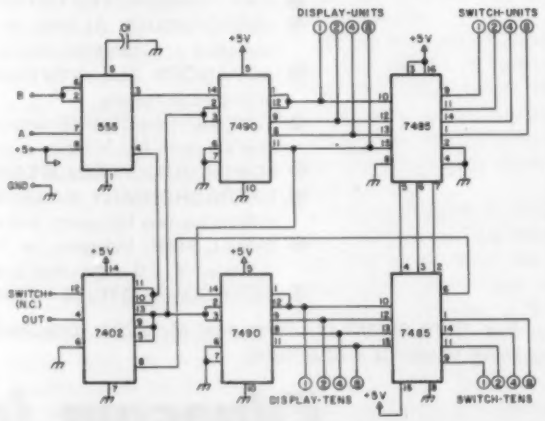
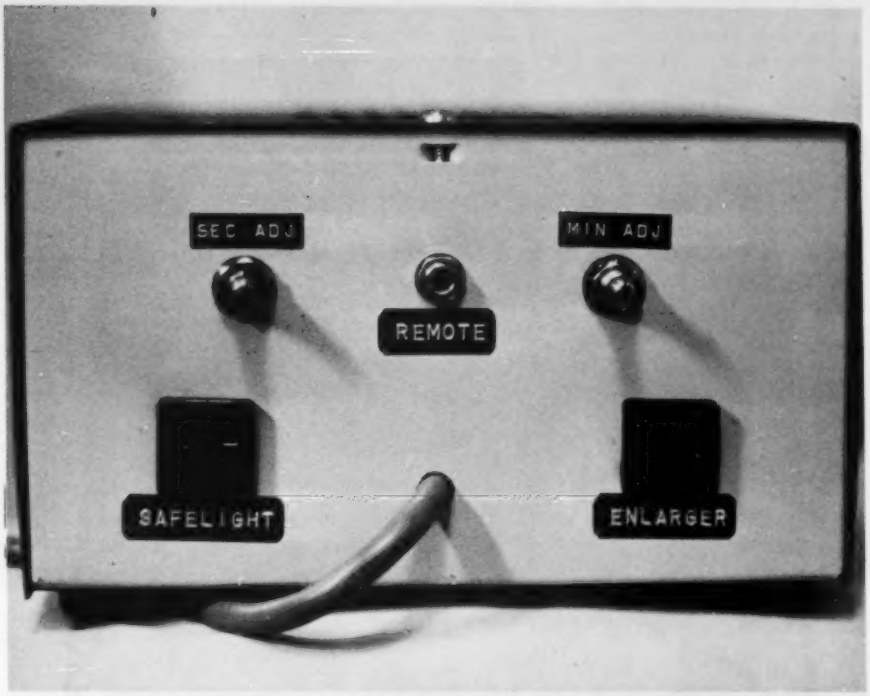


Fig. 2. Main board schematic.

ing-in."

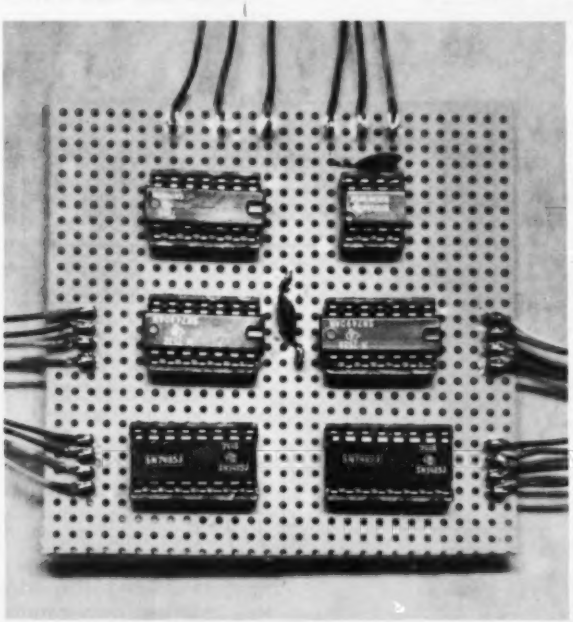
By an amazing coincidence, the timer described in this article does just these things!

A glance at the completed unit will illustrate the major features of the timer. Time desired is entered through two binary coded decimal (BCD) thumbwheel switches on the upper right corner of the front panel. A two digit, seven segment light emitting diode (LED) readout, located in the upper left corner, begins at "0" and counts up to the time preset, then automatically resets to zero. A large rocker switch in the upper center of the panel selects an interval of seconds or minutes. A "center off" position stops the count, to allow for a "hold" in the timing interval. Timing itself is started by depressing a momentary contact pushbutton in the center of the panel. A second rocker switch, located next to the power switch, activates the timer output, to energize the enlarger socket and extinguish the safelight *without* disturbing the timing interval, for as long as needed for focusing and composition. On the rear panel, grounded ac sockets are provided for ENLARGER (*on* during timing interval) and SAFELIGHT (*off* during timing interval). Additionally, a phone jack is provided for footswitch or remote triggering of the timer operation. Potentiometers adjusting second and minute intervals are also located at the rear panel.

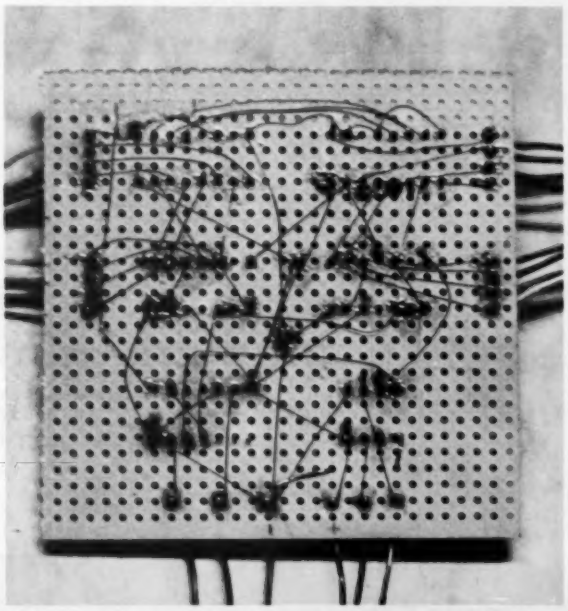


Rear view of unit.

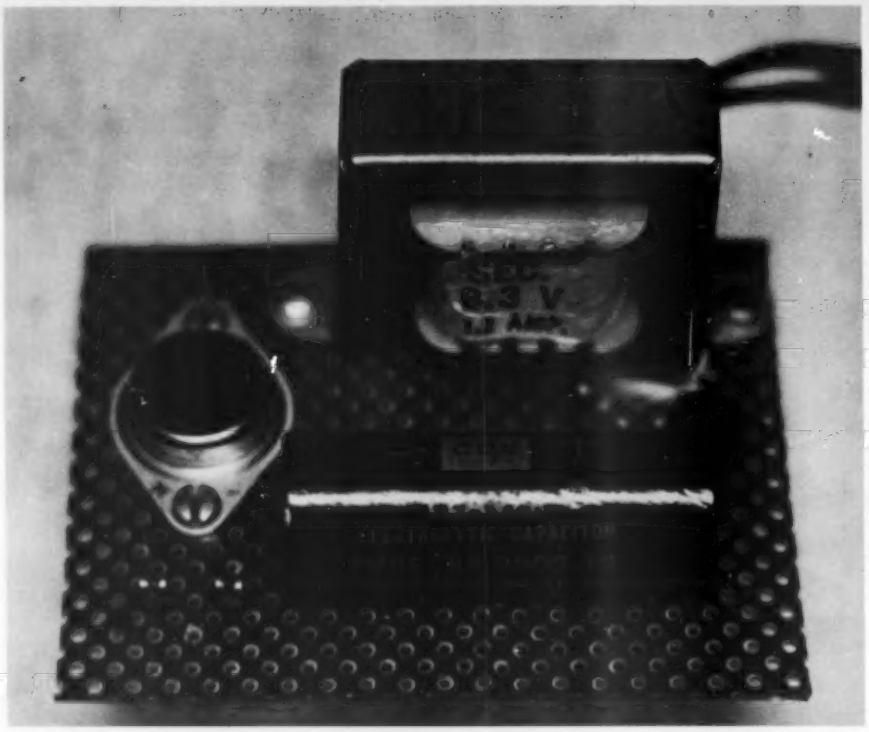
The timer is designed in a modular format, with separate circuit boards for each subunit. The power supply, main timer board, display, output, and complement generating sections are individual perfboards in the prototype. This allows flexibility in construction, and ease of modification or updating in the future. Printed circuit layouts for the



Main timer board, component side.



Main timer board, underside, showing wiring done with Vector wiring pencil.



Power supply board.

major boards are included for readers who wish to duplicate this method of construction.

A look into the circuitry of this unit is interesting, and provides a practical lesson in TTL logic devices. The versatile 555 timer chip sets the pulse for this circuit. Either 1 Hz (one pulse per second) or 1/60 Hz (one pulse per minute) is derived from suitable components in the astable mode. This clock output then goes to a pair of 7490 decade counters, connected in cascade. The BCD output of the 7490s is available at the board edge for coupling to the display board. Internally, the output of each 7490 is routed to the A input of a 7485. This chip, which has seen little use in amateur publications, is a four-bit binary comparator. Taking two four-bit binary "words," and BCD is just such a "word," it will give a "1" output if the four bits at the A input are identical to the four bits at the B input. Alternately, "greater than" or "less than" outputs may be selected so that the output is high with A greater than or less than B, respectively. Cascade inputs and outputs are available, and are used here, so that output from a

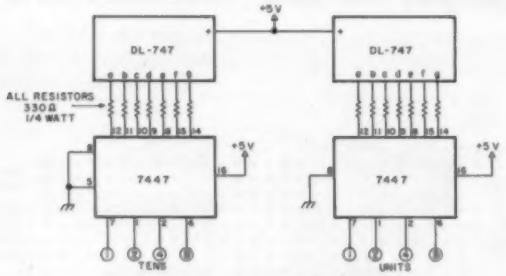


Fig. 3. Display board schematic.

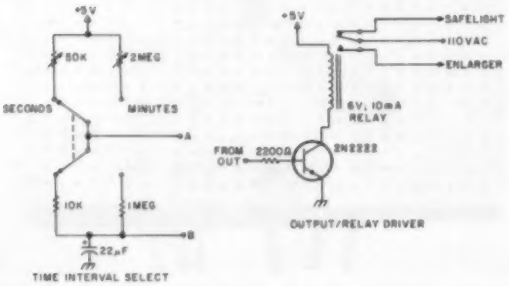


Fig. 4. Peripherals.

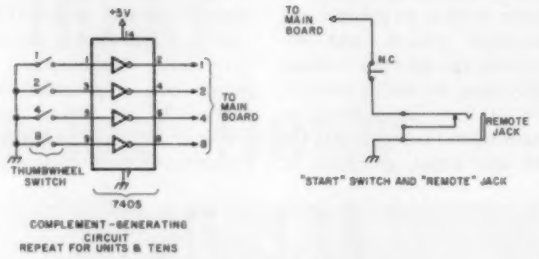


Fig. 5. Options.

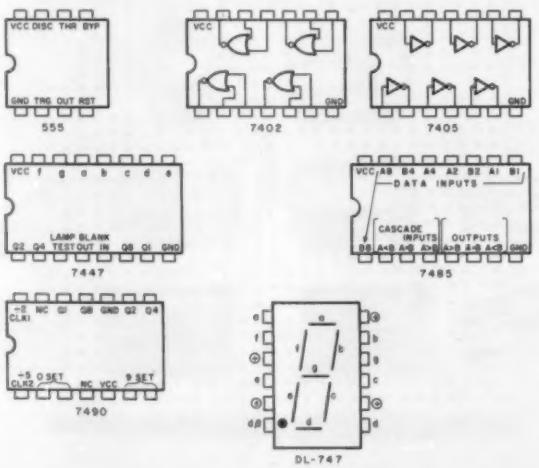


Fig. 6. IC and device basing diagrams (top view).

given chip is dependent on the next chip up the line. Here, the "1" from the "tens" (most significant) A=B output is only available when *both* the "tens" and "units" (least significant) A and B inputs are equal. The B input to each 7485 is provided by user-defined selector switches located on the front panel, and is connected through contacts along the edge of the main board. Interface with the outside world is provided by a 7402, which has two of its NOR gates connected as an RS type flip-flop. Lifting the ground on the S input raises the 555 reset line to logic 1 (high) and starts the clock. The logic 1 output of the 7485, when the BCD count from the 7490 agrees with the preset count, triggers the R input of the flip-flop, grounding the reset line to the 555, stopping the count, and clearing the 7490s to zero. An output state is then available, which is inverted with another NOR gate in the same chip, and presented for triggering outside equipment. The condition at the connector is "0" when not counting and "1" while counting.

Display is provided by a conventional seven segment LED display, with 7447 decoder-drivers. Observant readers might note the ICs on the prototype are marked SN38841. These are pin for pin equivalents of the specified 7447s. The "tens" digit is hard wired to zero blank to improve display legibility and lower current drain. Although large 0.6 inch type 747 displays were used in the prototype, any common anode display could be used. In fact, any readout capable of presenting the BCD data could be built, from four LEDs to nixies. The display could even be omitted entirely if not desired.

The B input to the 7485 requires BCD complement. Although complement mode thumbwheel switches are obtainable, only straight BCD switches were available to this writer. A small board with two 7405 hex inverters was put together to generate the complement of the number selected. If complement switches are used, omit this board entirely, and connect the switch directly to the main circuit board.

The driver/relay circuit is straightforward tradition. A 2200 Ohm resistor couples the output from the 7402 to the base of a 2N2222. The emitter is grounded, and a 10 mA, 6 V dc relay is connected from +Vcc to the collector. The power supply is also an unadorned five volt regulated supply, and no special comments are warranted. The experimenter is invited to use my circuit, or any favorite of his own.

Construction may be by any technique desired. While perfboard wired with a wiring pencil was used on the prototype, printed circuits are certainly more convenient, and layouts are included for those desiring same. Standard TTL precautions of lead dress and bypassing should be followed. Particular care should be taken in wiring the ac sockets on the rear skirt. Cabinet, placement of controls,

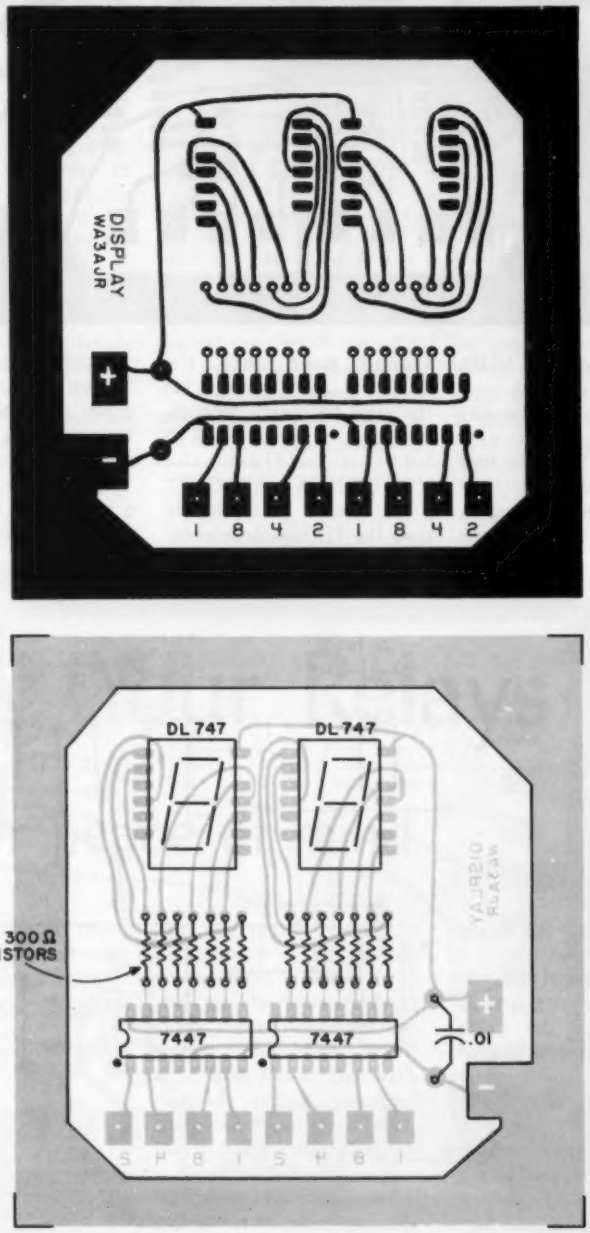
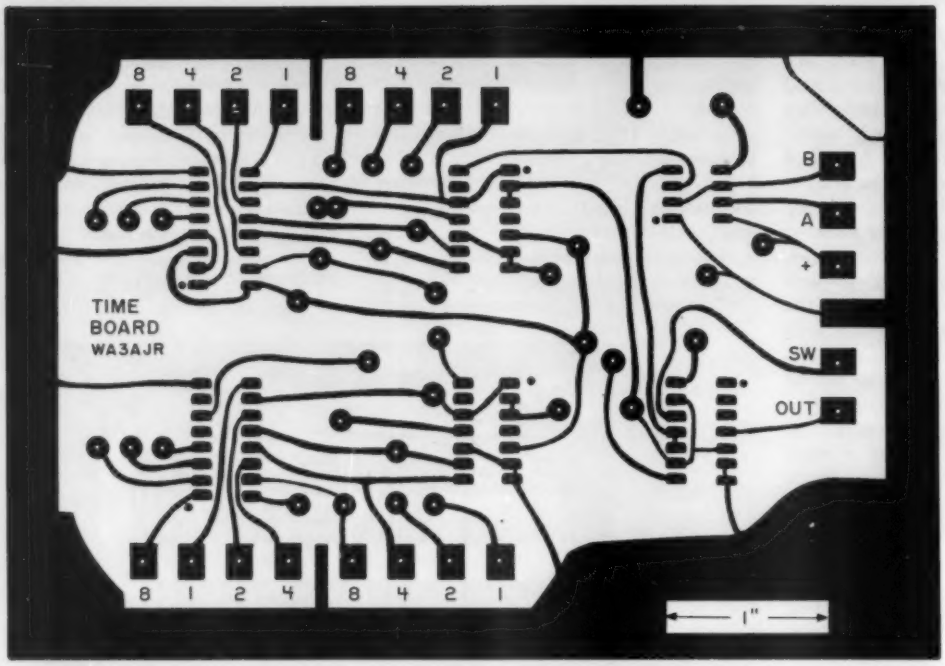


Fig. 7. PC layout, timer board.



painting, etc., are left to the whims of the individual.

Once completed, the only task remaining is calibration of the timer. With the unit turned on, and the interval set to "SECONDS," plug an electric clock with a sweep second hand into the "ENLARGER" socket. Set the time to ninety seconds, and push the "START" button. Adjust the "SECONDS ADJUST" potentiometer to accurately time the 1½ minute interval. Similarly, with the timer interval set to "MINUTES," adjust the appropriate potentiometer to the correct number of minutes indicated. This does, by necessity, take a bit longer! It is important to note that, because of peculiarities inherent in the 555 timing circuit, the *first* interval will be somewhat longer than all succeeding ones. In the prototype, the difference is about 33%. Thus, the first second is really 1.33 seconds, with each

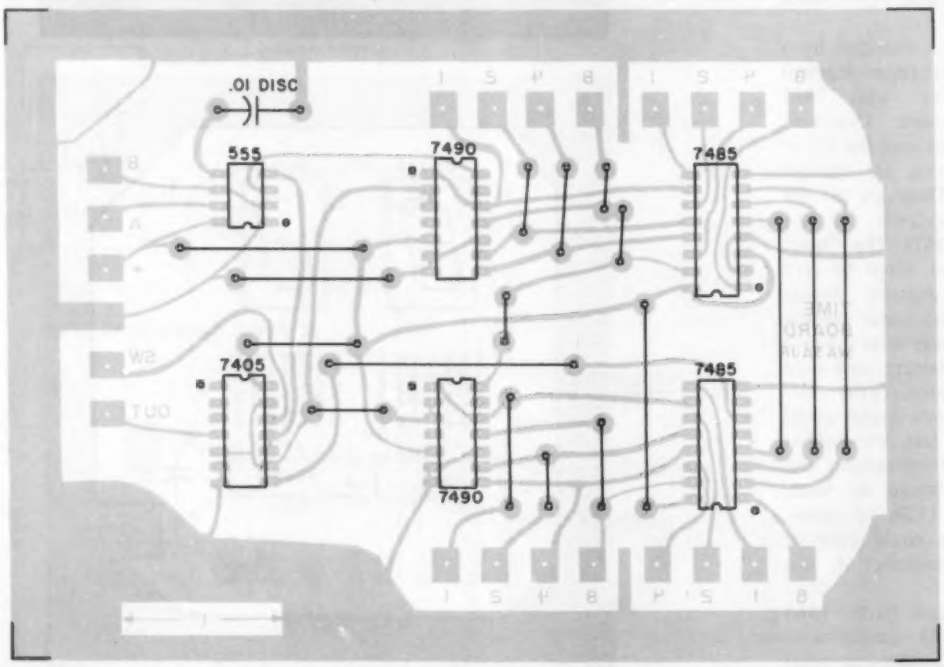
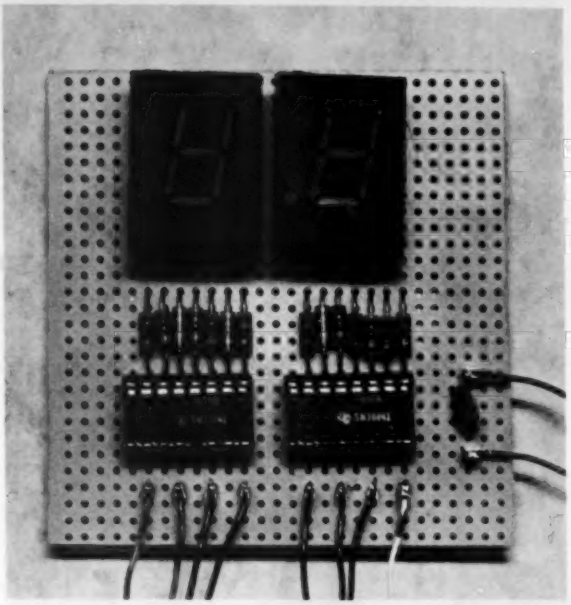


Fig. 8. PC layout, display board.

succeeding second 1.0 second. In the minutes mode, the first interval is 80 seconds (1.3 minutes) with each succeeding minute 60 seconds. For all but the most critical applications, this error, once acknowledged, is acceptable. Further, remember that the stated accuracy of a 555 is 3%, or within about two seconds per minute.

All right, already, "I've built the timer," you say, "now how do I use it?" Well, that all depends on what you plan to do with it! Let me assume, for the moment, that darkroom use, for enlarger control, is desired. Plug it in and turn it on; look at the display, where a single "0" should be evident. Connect the enlarger to the ENLARGER socket and the safelight to the (you guessed it) SAFELIGHT socket. Note that with the relay specified, not more than 100 Watts should be drawn from either socket. After going through the appropriate photographic manipulations to determine correct exposure time, set the desired interval on the thumbwheel switches. Interval selection would normally be SECONDS. The FOCUS mode may be used for composition and focusing as desired. When all is ready, making sure the FOCUS mode is off, hit the pushbutton and sit back to watch the numbers flash by. As the enlarger is on, the safelight should be off. At the completion of the timing interval, this situation should reverse itself.

But what else can you do with it? Set the timer to ninety minutes and plug your television (under 100 Watts, please) into the ENLARGER socket and fall asleep to Johnny Carson. Or plug a bell into the SAFELIGHT socket and let your wife use it for an expensive (although not very) cooking timer. Who knows what you might do with it? This thing is so useful, you can let your mind run wild!



Display circuit board.

So go have a ball with this darkroom and every room accessory. If you have any questions, or just want to let me know that you built one, or like the article, feel free to write. But *please*, if you want a reply, enclose an SASE. (And maybe a picture?) ■

John Skubick K8ANG
1040 Meadowbrook
Warren OH 44484

Cooling Your Relays

- - for peace of mind

Some of my wire antennas have relay direction switching. Consequently, the relay holding times may be up to a couple of hours or so! Plus, the thought of those relays baking in the afternoon sun tends to give me nervous jitters.

I borrowed this circuit from my model railroading hobby. The basics are used to operate track switching machines. With a change in values of R and C, I found that my antenna relays operated normally, but were drawing less current, while being held open – therefore, cooler running.

Most dc relays will remain fully operated at one-half to three-fourths of the rated coil voltage. The problem is to still get the relay to snap-close under full rated coil voltage, and then shortly after, have this voltage automatically reduce to about three-fourths, to give a reduction in holding current.

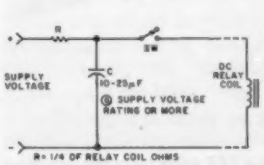


Fig. 1.

When your dc relay supply is on, and relay control switch SW is open, capacitor C will charge to full supply voltage. When SW is closed to operate the relay, the charge in C will *operate* the relay normally. However, when C's full charge is reduced by the relay coil, further full charging is prevented by the current being drawn by the coil through R. Now, the relay coil is receiving a reduced voltage and current to hold it operated in its fully closed position.

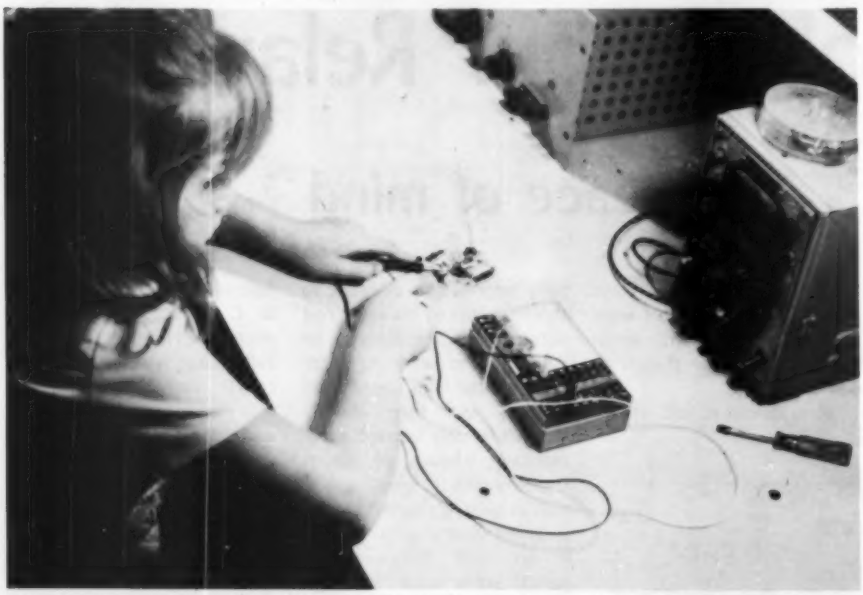
A couple of extra components are certainly worth a little peace of mind. ■

A Look At Soviet Test Gear

-- what you're missing

Sam Kelly W6JTT
12811 Owen Street
Garden Grove CA 92641

One of the more enjoyable benefits of being an electronic engineer is the opportunity to meet engineers from other countries, many of whom are hams. While working on an international program, I met engineers and trade specialists from the Soviet Union. They are anxious to improve trade relations with our country to help with their balance of payment problem. So far, the bulk of trade has been in raw materials and commodities, very dull stuff to the electronics enthusiast. Not knowing much about their equipment, I was very curious about its design, the type of semiconductors used, how good it is, and the prices. They have a state monopoly on all manufacturing industries, so all electronic equipment is sold through state trading organizations. Test equipment (VOMs, counters, scopes, etc.) is sold by Mashpriborintorg, electronic components by Elektronorgteknica, and communications equipment by Sudioimport. This approach results in a high degree of standardization throughout their country. It also results in fewer innovative designs by their engineers.



The simple panel layout and absence of switching make the U-4323 ideal for the younger experimenter.

From my contacts, I received two pieces of test equipment for evaluation. Both of them had useful features not found in instruments currently on our market. The first was a small multimeter, the U-4323. It is designed for the hobbyist and ham radio operator. It is similar in appearance and outward construction to many Japanese import instruments in its price class. Range selection is done by plugging the test prods into the appropriate tip jacks. Unpacking the instrument, I discovered a small package with spare diodes and a spare meter fuse. A comprehensive operating handbook – in English – complete with circuit diagrams and maintenance data was included.

A quick glance at the panel revealed that in addition to being a conventional VOM, it contained an audio oscillator and signal generator! The output of the audio oscillator is a 1000 Hz square wave. The rf output was fixed

at 465 kHz, the standard i-f for their country. It was modulated by the 1000 Hz square wave. A quick check with my communications receiver revealed that the harmonic content was quite rich. It was usable as an alignment source to well above 30 MHz. The output level of each of the outputs was a good solid 0.5 volts. The circuit is quite clever, using three germanium PNP transistors. Two are used for the 1 kHz multivibrator, the third is an L-C controlled oscillator which is base modulated by the multivibrator. The packaging of the transistors was quite distinctive, being a combination of the TO-5 style and the old "top hat." All components appeared to be very well made, particularly the meter movement, which is a rugged taut band type of construction. Diode protection is also provided.

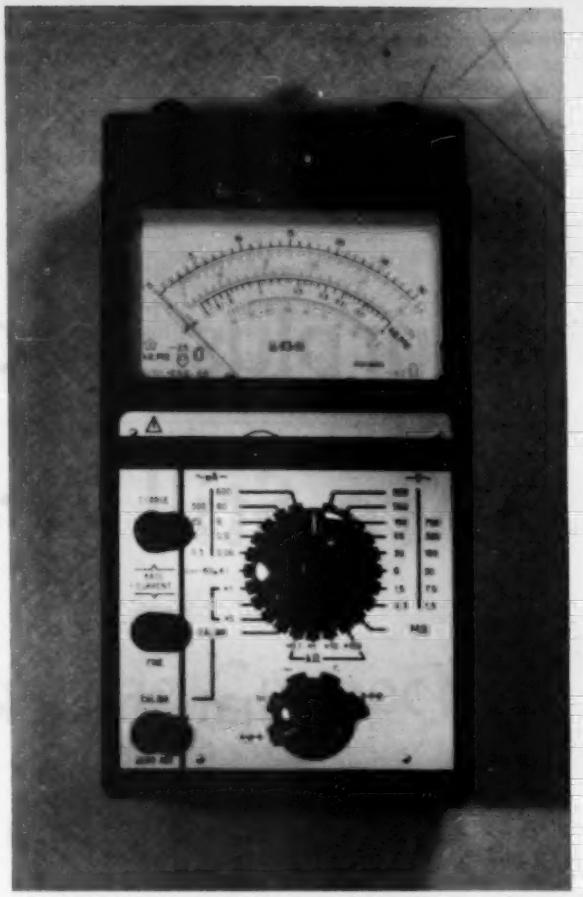
The little handbook is quite comprehensive, going into the theory of operation for the oscillator circuit. The 40 microamp meter movement is described in such detail as to permit field repair and rewinding of the meter coil. A section is devoted to the variation of readings due to changes in ambient temperature, battery voltage, meter position, and the frequency of ac voltages. All measurements are illustrated by simple one function drawings. It was evident that the manufacturer realizes his instruments will be used in a wide range of climates by people who may not be too well trained.

The U-4341 is a combination instrument that incorporates a transistor tester with a high quality conventional VOM. It is a quality instrument that would be classed as a bench test instrument adequate for commercial service work. It is housed in a black plastic case designed for tabletop use. Rated accuracy is 2.5% for dc and 4% for ac ranges. Ac frequency response is from 45 Hz to 20 kHz. Both ac and dc currents are measurable. The instruction book is very comprehensive and, like the one for the U-4323, provides a lot of information for the user working in out-of-the-way places.

Another nice feature is the inclusion of special low range scales. The lowest ac current range is 300 microamps, dc is 60 microamps. The lowest dc voltage range is 300 millivolts full scale. The most interesting feature is the built-in transistor testing circuit. The meter will measure Icb, Ieb, and Ici (defined as initial collector current as measured in the common emitter configuration with zero emitter-base voltage) with an accuracy of ± 2.5%.

The quality of the instruments is quite good when the price class is considered. Both instruments are well sealed against dust and moisture. Battery replacement is accomplished by removing the back plates. All instruments have manufacturing seals placed by their quality control department to reveal any tampering that might void the warranty. A separate certificate of inspection giving the performance specifications and quality assurance signoff is packed with each instrument.

Reading the manufacturer's literature provided insight into the type of equipment available to the Soviet ham. There appears to be no production of strictly amateur radio equipment in the Soviet Union at this time. This means that the Soviet ham has to build his own or modify military surplus equipment. This is made available to him through DOSAFF, an organization that has no American equivalent. It is a civilian auxiliary for supporting the armed forces, and would be roughly analagous to having MARS, civil defense, the National Rifle Association, sport parachuting, and other paramilitary activities rolled into one super organization. Soviet defense policy places significant emphasis on having a trained cadre of civilian radio operators available to assist the military in the event of war, so they supply individuals and clubs with equipment much in the manner that our MARS program is supposed to operate.



The U-4341 has a neat straightforward panel layout. Note the universal transistor socket at the top.

In browsing through their equipment catalogs, I came across a number of test instruments that would be of interest to hams in this country. Among these was a neat little 3 inch scope. It had a calibrated triggered sweep, 10 MHz bandwidth, built-in calibration, and a number of other desirable features. Again, there was a design twist — this scope was designed for the hobbyist with limited facilities to maintain his test equipment. Although of recent design, it was designed around a series of high reliability vacuum tubes to minimize the number of components.

If and when these products appear on our market will depend on the political situation. One of the major stumbling blocks is the lack of a "most favored nation" treaty with the Soviet Union. Lack of such a treaty results in drastically higher import duties that would price the products out of the market. There has been a great improvement in relations between our two countries in the past few years. Hopefully this will continue so that we will avoid blasting each other off the face of the earth! With the ever-increasing prices of Japanese electronics, we may see a day when the USSR will be a major supplier of popular electronic equipment. ■

K. W. Moak
Northwood NH 03261

Surplus Goodies Are Still Around

- - what to look for

Almost everyone in electronics makes liberal use of surplus material, not only because of the price advantage, but also because there are a number of surplus items which aren't generally available in ordinary stores. In the past, most surplus outlets dealt primarily in radio equipment, with a certain amount of radar components and maybe an occasional computer unit turning up. In those amazingly remote days before solid state electronics and computer technology, the surplus buyer could identify just about anything he might run across, and if he couldn't, the man who ran the place could look it up.

All that has changed, for better or worse. Browse around a surplus store today and you'll be lucky to recognize half the stock; even the store's owner will often throw up his hands in a "you've got me" gesture. The new space age technologies have spawned a flood of incomprehensible components that tend to pile up in the back room simply because nobody really knows what they are.

It's a real shame that more people don't know, or don't care, about these unknowns, because they're *good*. For one thing, they are often a step ahead of state-of-the-art, utilizing principles that commercial products haven't gotten around to yet. Microwave technology in particular has entered the twenty-first century, and much aerospace surplus involves microwaves. They are generally built to incredibly high standards, especially if they come from NASA; some of those components make the proverbial Swiss watch look like a dime-store can opener. Finally, and most importantly, they are cheap compared to the usual surplus fare. A few cautious purchases can yield a small fortune in cannibalized parts alone, and if luck is with you, you might walk away with a fine UHF amplifier for the price of a bag of capacitors.

So how do you figure out what is good, or even what something is? While there isn't any cut-and-dried method, there are a few rules of thumb that can help turn surplus shopping into a real treasure hunt.

Suppose you have, while browsing through your local surplus emporium, come upon a whatsit that looks interesting. After checking it for identifying marks and finding none, you take it up to the cash register, where the man says he doesn't have any idea what it is, but you can have it for five bucks. Should you get it? After all, five dollars in these days is rich food for a junk box stuffer.

The first thing to look at is the provision for input and output. This might likely be in the form of plugs, sockets, or waveguide flanges. The number and type of connectors can tell you a lot about the unit. If there are a good many plug-in contacts and no waveguide, there's a good chance you've got some kind of logic device. If there is one or more BNC connector, expect high frequency circuitry. If there are waveguides but no wires or plugs, don't bother with it unless you like to work with waveguides, because you won't find anything else inside. If there are waveguides and electrical connectors, then you might have an amplifier or oscillator. If there are very small coax connectors, you probably don't want it, since the odds are it is a stripline unit, and that whole field is generally outside the reach of a hobbyist.

Next look for identifiable parts. A sticker reading "Danger, Magnetic Material," or the like will usually be affixed to a magnetron or traveling wave tube. In addition, the latter, of which there are a bewildering variety, are often relatively long and thin metal tubes. If you see waveguide involved with gearing or other mechanical linkages, expect a tunable cavity, which might indicate an oscillator or measuring device. A rotating cylinder or drum with movable pins or tabs might be a programming unit.

If, after examining the device, you decide to buy it, don't forget to make the same checks you would for a conventional component. Look for evidence of water soaking or heat discoloration, not to mention dents and other physical damage. Remember that even the rarest find isn't worth a cent if it's broken.

After you get your treasure home, you'll probably want to delve around in its insides. One word of caution: Some microwave tubes use a very poisonous beryllia ceramic inside. They are usually marked with a warning, but to be on the safe side, don't open anything that looks like a traveling wave tube, even though there may be some very inviting setscrews on the end. Even a few

particles of beryllia can cause cancer if inhaled. There is also a slim but real possibility of radioactives being used in some aerospace equipment. Any component containing even a slight radiation source will be marked with the purple trefoil. If you see it, it might be prudent to return the unit to the store; you certainly won't have a use for it.

The odds are against finding either of those things. Probably you'll uncover some conventional PC boards with conventional, high quality components on them, various waveguide devices, and perhaps some stripline units. These latter will probably be slim metal boxes, anywhere from one to five inches square. Inside the boxes you're likely to find only conductors and junctions. If you're very lucky, you'll recognize the innards of your buy as a whole unit, say an amplifier, and be able to use it as is. If you're very unlucky, you'll find all the circuitry encapsulated in cement, or incomprehensible stripline boxes, or something you still can't identify. In between these extremes, you'll find some good usable parts or some that may be usable someday — junk box stuffers.

If you can find a manufacturer's name and a model number, you might try writing for information. Some manufacturers are very helpful, some are not so helpful, and some are helpful but charge for spec sheets. Remember that an SASE is always called for.

With a little practice, anyone can come up with other rules of thumb, taking into consideration size, materials of construction, and geometry. But if you do buy something that neither examination nor requests can identify, don't feel too bad. Someday you may see that gold-plated, waveguide-studded, epoxy-potted treasure in a catalog for fifty dollars. And if you don't, it will still make a fine bookend. ■

Tom French WA4BZP
909 Society Ave.
Albany GA 31701

The Touchtone Connection

- - quick mod for the Standard HT

Two years ago I installed an older version Data Signal touchtone pad on a Standard. It was very difficult due to the thick metal I had to cut through in addition to the plastic thickness. It was hard to take out of the carrying case, but the alternative was to cut an opening in the case. This idea I rejected, since I thought it would ruin the appearance of the case. Since convenience is the main purpose of having a handie-talkie, I was pleased to discover that Data Signal's newest touchtone pad (TTP) is only .050 inches thick and made of a mylar-covered mask with stainless steel wells and gold-plated circuits. With this pad there is no need to cut the carrying case at all, giving the project a more professional look. I recently purchased a new Standard HT and installed the new trim TTP. I found that I could operate the new keyboard (KBD) with the HT inside its case. Those who may not be able to or want to do this will be glad to know you can apply a "peel and stick" facsimile of the TTP on the leather case directly over the actual TTP on the HT. I was lucky enough to acquire a "peel and stick" mask of the KBD from Data Signal which is located here in town. Now I will do my best to explain the installation of the TTP and give you some of the reasons I think it is a good idea.

This time I decided to place the TTP very low on the front panel of the HT. I chose this position because all you have to cut through here is plastic, and this placement looks best. Here are some things needed for the project other than the HT: Data Signal TTP kit*; file — very small; electrician's knife; two base, clear epoxy; masking tape; soldering iron and solder.

Remove all knobs and the main PC board from the chassis. Lay the TTP circuit board on the inside front for approximate final placement. Check for fitting and then install the crystal near the top as close as possible to the TTP circuit board. Lay some sort of insulation tape on the metal sub-chassis and then solder the wires to the circuit board. Care should be taken not to get solder in the holes on the bottom of the KBD. Now solder the other wires to the TTP circuit board. Next place tape over the circuit board to insulate it from the HT's main board. The extra wires should be taped down too. Three wires are run to the right side of the HT up to the PL socket where #1 is "ground," #3 is "power on transmit" and #8 is "external audio input." The leads are tinned and stuck in the socket. Also, a 50k helipot is used here to control the audio into the HT. The center wiper arm on the trimpot is the audio input from the encoder, and one lead should go to ground and the other lead to #8 PL socket.

The pad is glued firmly on the HT with epoxy. This must be used sparingly and with much caution not to allow the epoxy to get into the holes on the bottom of the KBD. These are for breathing. Allow the pad to conform to the curvature of the HT as the KBD is flexible. After gluing the KBD on the HT, tape it down with masking tape and let it stand overnight until glue is completely dry.

Try to put the HT into your desk top charger if it fits without pressing on the KBD. If not, take the knife and cut the ribs out of the inside of the charger. Then file this area down to a smooth finish.

I hope others will enjoy this project as much as I did. I think this is by far the easiest TTP arrangement and most professional-looking installation for the Standard HT. ■

*Data Signal Inc., Commerce Lane, Albany GA.

Don Moore
800 North Shore Dr.
Crystal MI 48818

Build A Phone Exchange

-- using dial telephones

The telephone is one of the most useful devices available for communicating around the house, farm, or place of business. Unfortunately, most of us are usually forced to either rent equipment from the local telco, which can be rather expensive, or settle for war surplus magneto phones. There is another solution, however -- that is, to construct your own dial telephone system.

This may seem to be an awesome project for many; however, the exchange doesn't have to be a ten thousand line crossbar unit with push-button dialing. A simple but efficient switching system can be built at reasonable cost, and with only a few hours work. In order to keep the cost minimal, and the construction simple, we are going to forego some of Ma Bell's luxuries, which are really unnecessary anyway. What we will be left with is a streamlined version of a commercial telephone exchange which will be best suited for private use.

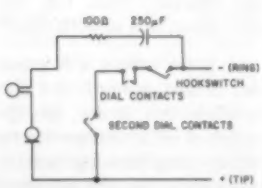


Fig. 1.

The theory behind our exchange is basically the same as with commercial systems, that is, circuits to distinguish between on and off hook conditions, supply talk voltage, count the impulses from the dial and make necessary selections, and provide a way to apply ringing current to the desired bell. In most commercial exchanges, the talk voltage used is 48-50 volts dc, while the ringing current is 90-105 volts ac, at frequencies between 20 and 50 Hz.

Most commercial switching equipment also operates from the talk voltage. In the majority of professional systems, the ringing current is obtained from motor-driven ringing machines, or from static ringing generators. In our exchange, we will use 26 V dc for talk, and steal the 110 V house current for ringing the bells. Most telephone ringers will operate satisfactorily at this higher frequency with only minor adjustments. This is really the easiest method of ringing -- as you do not have to change the bells in your phones. We will also make use of the three wire system -- that is, three conductors leading to each subset. This alleviates the need for more sophisticated equipment, and saves on expense.

In general, our switching system operates using the following pattern: All telephones in the system are connected to the exchange at the terminal block. There are three conductors per station, which are broken down to color codes red, green, and yellow. The red and green wires of all stations are interconnected in parallel with the dc power supply, with the positive going to red, and the negative to ground. The yellow leads are separated -- and given their own terminals. The talk circuit and the dial impulses use pair red-green, while the 110 V ac ringing current goes over conductors yellow (+) and green.

In series with the dc power source is the line relay -- which responds to the off-hook condition, and also relays dial impulses to the connector. I chose to have the uniselector powered directly by the 110, although this is not mandatory. The uniselector coil voltage is controlled by the line relay. When a telephone is lifted from its rest, the line relay closes, and provides talk voltage. At the same time, it causes the uniselector to advance one step, which is the "start" position. Additional pulses will drive the stepper until it rests on the desired contacts -- causing the 110 V to be applied to the yellow ring line.

Our exchange makes use of the common talk-selective ring principle, which is very economical for low use applications. There is no need for a busy signal in this system, as you can tell immediately upon lifting the handset if the system is being used.

Due to the fact that our system uses a three conductor wiring plan, it may be necessary to alter the connections at the subset. In my exchange, I use imported

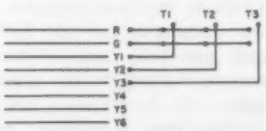


Fig. 2.

Ericsson-type telephones, which are intended for use with either two or three wire systems. No modification is required. Also, the European telephones have high frequency "straight line" ringers which do not need retuning. Other types of telephone sets will operate equally as well, but, as mentioned earlier, it may be necessary to retune the ringer. This may be accomplished simply by adjusting or removing the weighted striker, or experimenting with the screw settings.

If the telephone is of the type which is normally intended for use with standard U.S. two-wire networks, you may have to change around some of the wires on the phone's transmission network, so that the ringer will be connected to both yellow and green. There will be no problem with the talk circuit – just remember that the conductor codes are red and green for this, and that green is shared with ring.

It is also possible to rewire the telephones so that the receiver element will buzz loudly instead of having the bell ring. This would only occur while the telephone was on the hook, and the receiver would be used for regular speech upon being lifted. Fig. 1 gives you a representative schematic for "receiver ringing."

With regard to the types of wire and cable used for connection, I used eight conductor cable leading to the subsets, with three conductor cable tapped into it where needed. In order to save on wire, I used one pair as the talk circuit for all stations, but gave each station its own ringing line. This practice is illustrated in Fig. 2. I would definitely recommend that terminal blocks be used at the subsets, if possible. This is only good wiring practice, and saves a lot of grief. With our mini-exchange, I do not really recommend that this be done, as speech quality is diminished greatly. For best results, use metallic paths on all circuits. Remember that you are using 110 V ac for ringing, and make certain that all wiring is suitable for carrying this.

I should mention that the speech quality of your exchange will depend to a great degree upon the wiring job. That is to say, loose connections and this sort of thing will cause scratchy, almost unintelligible circuits. Also, the type of dc power supply used will play a great part in the speech quality. There will be some noise from the ac parts of the exchange, and the moving parts, but this should not impair conversation.

In my exchange, a ringing signal may be heard in the receiver; this is derived from the 60 Hz hum present on the line when the uniselector is connected with it. As was previously mentioned, there is no need for a busy signal.

Before you start construction of your own exchange, you should plan carefully in order to determine your telephone needs. The basic exchange circuit is intended to take care of ten numbers, or telephones, although with modification more could be used. It would be helpful if you had the telephones which you will use in the system on hand during construction.

Building the exchange is really a "trial and error" process; that is to say, you build a stage, test it, and hook a couple of stages together to see if it will all work properly. As you build your exchange, you may find certain modifications which will better suit your needs. This project is of the type that lends itself to further experimentation.

Now that we have discussed the theory and applications of our exchange, we can venture into the construction end of the project. You will notice that there are but a few parts used in the system, all of which can be obtained without much difficulty. It is important, however, to use a uniselector (stepping switch) which has ten positions, with automatic reset. The counting operations in this exchange are on a decimal basis, and therefore it is important that the counter correspond likewise. There are many different types of steppers available, but I have found that the only one usable in our system is the unit with ten positions.

The inexpensive 25 position uniselectors which flood the market are generally not used as connectors, but are employed in the line-finder stages of commercial exchanges. Other than this note on the counter, components may be as varied as need be. Most of the exchange can be put together from junk box parts.

Construction itself is remarkably simple; just use good wiring techniques, as you would with any project. The components used in the exchange are rugged, and will take lots of abuse. I have never had to replace a single part in the three years since I built the unit. Another thing to remember when assembling the exchange is that the green wire serves as a common ground, and must be connected to all areas requiring low voltage negative. If you have problems with the phones not ringing, I would check the green wire to make sure that it links all stages of the system.

When you are ready to wire the uniselector, choose the station numbers using digits two through ten. This system uses digit one as a starting point, and the line relay automatically sends the connector to this point. Also, if digit one were used, jiggling the hookswitch could accidentally call a station. Fig. 3 gives you the complete schematic for the exchange.

Once you have completed wiring the exchange, you should test it, looking for possible short circuits and connections which might rub against each other. This is especially necessary at the

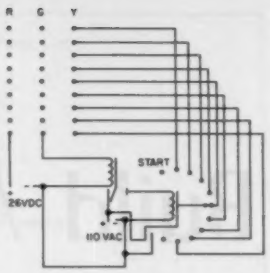


Fig. 3.

uniselector. Make sure that the correct voltages are reaching the subsets – and that the talk circuit uses red-green, and ring has yellow-green. Accidental reversal of these color codes could result in your telephones being damaged.

With the automatic reset, the uniselector should return to the rest position when you hang the phone up. Some adjustment of the stepper may be necessary. Again, trial and error adjustments will be required from each exchange. I have used phones up to a half mile from the exchange without appreciable loss in transmission volume or ringing. This system is quite flexible in its uses, and provides much for very little money.

The characteristics of operation are as follows: On picking up the handset, the line relay closes and a dc hum may be heard in the receiver. The uniselector has also stepped to its first position, and is ready for your instructions. When you dial, the stepping switch moves forward in synchrony with your dial pulses. Immediately at the end of the pulse train, 110 V ac is connected to the bell of the called telephone and it rings. The ringing will continue until the called party answers, or until you hang up your telephone.

This telephone system *should not* be interconnected with any commercial systems, as the dc from your exchange will cause problems for the switching equipment at the telco, and perhaps give you a chance to meet some of Ma Bell's attorneys. ■

Build A Brute Power Supply

-- completely regulated and protected

Tom Lawrence WB4QLW
P.O. Box 3524
Danville VA 24541

Having recently purchased a new solid state 80 through 10 meter transceiver, I couldn't bring myself to lay down some additional long green for a +12 V dc power supply. Check the prices and you will see what I mean. So I got busy and looked through stacks of my ham magazines to find a supply that would suit my purpose. That is, +12 to +15 V dc at about 20 Amps intermittent and 9 to 11 Amps constant current that is well regulated. I had built one such supply last year for my 2 meter amplifier which was good for about 8 Amps. This was an article in *73 Magazine* by Warren MacDowell in the May, 1975, edition. I would suggest to anyone desiring to build this type of power supply to read that article whether or not you are going to build that supply or some other, as it contains some very good technical information laid down at ground level.

While having no problems with the circuit, I did have trouble finding the parts locally. What I ended up with was not as attractive as the one pictured, but it did a great job and still does. All of the parts on the regulator board are very easy to find if you substitute ½ Watt resistors for the ¼ Watt ones. Radio Shack and Lafayette seem to keep an ample supply. The same with the LM723 chip. I could not, however, find the MJ3000 Darlington anywhere locally. Good high current pass transistors will work as well as the Darlington for this purpose, and I might add that that is what we use in our computer power supplies for the most stable operation. The best you can get is the 2N3055 or equivalent, as they are less susceptible to going haywire with some rf feedback. You can drive 4 of these goodies with a single 2N4911 or equivalent and, by putting .3 Ohm resistors on the emitters of the 2N3055s, you can safely draw up to 25 Amps of current at +13.8 V dc intermittent and about 18 Amps continuous (that is, provided you heat sink all 5 transistors, driver and pass).

I used two 15,000 uF capacitors for better regulation, but they don't have to

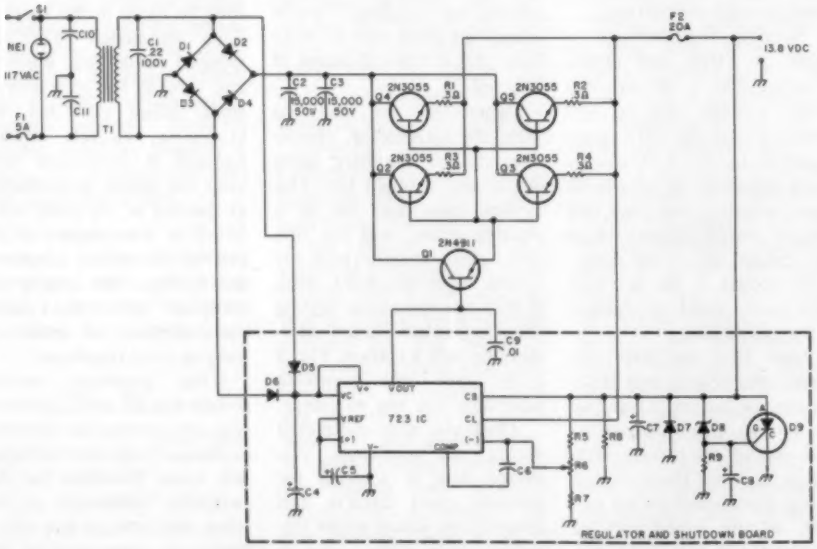


Fig. 1.

be two of that exact value. You can use what you can find and, as long as they total up to between 25k and 30k uF, you will be OK. The voltage ratings should be at least 40 V dc and 50 V dc surge.

I had a couple of old TV transformers around and I put them in series to get about 19 V ac; with a bridge rectifier and all the capacity, I had my 25 V ac for good regulation. One of the transformers had a single 6.3 winding at about 8 Amps and the other had both a 6.3 winding and a 5.0 winding both rated at 7.5 Amps. This works out fine, but I was able to find a single transformer at a hamfest with the secondary rated at 25 V ac at 12 Amps; it works very nicely.

Some other things I did differently were:

(1) Fuse both the input and output of the supply for 100% protection.

(2) Put .01 uF caps across the primary of the transformer to ground for good transient protection.

(3) Put a .22 uF non-electrolytic tubular capacitor rated at 100 volts across the secondary and bridge rectifier to aid in noise and rf.

(4) Put a .01 uF disc capacitor on the output of the voltage regulator terminal Vo to bypass noise that will be passed through the output transistors (incidentally, this shows up as sounding similar to ac hum if you have an FM rig connected to the supply, and it gives you an echo on your voice on SSB peaks).

(5) The last change that I made I feel is by far the best. I have a 15 volt zener diode constantly monitoring the output voltage. If anything happens and the voltage exceeds 15 volts, the zener conducts and fires the SCR and immediately crowbars the supply from the transceiver. It is extremely dangerous to solid state transceivers (any band) for the input voltage to exceed 15 volts. The 5 volt and 8 volt regulators in the rigs will not take it and you will fry one very easily. When the voltage does exceed +15 volts and the crowbar shuts it down, what has probably happened is that the regulator chip and the high speed diodes are blown for some reason, and by not permitting the 2N4911, your pass transistors will be saved. A parts layout is not shown, as it really is a simple circuit that can be etched or point-to-point wired easily, and again you can refer to the past article. ■

Parts List

R1-R4	.3 Ohm 10 Watt
R5	1.8k ½ Watt 10%
R6	2.5k trimpot
R7	2.7k ½ Watt 10%
R8	1.5k ½ Watt 10%
R9	1k ½ Watt 10%
C2-C3	15,000 uF 40 V dc
C1	.22 uF @100 V dc tubular
C4	250 uF @25 V dc
C5-C6	1.2 uF @35 V dc tantalum
C7	220 pF @25 V dc
C8	100 uF @25 V dc
C9-C11	.01 uF @500 volts
D1-D4	1N3492 or equiv. (100 piv @ 18 Amps)
D5-D6	1N4607 or equiv.
D7	1N4002 or equiv.
D8	1N965A or equiv. (15 volt zener)
D9	2N4441 or equiv.
Q1	2N4911 or equiv.
Q2-Q5	2N3055 or equiv.
F1	5 Amp fast blow fuse @ 125 volts
F2	20 Amp fast below fuse @ 125 volts
NE1	115 V ac neon indicator lamp
S1	Switch – single pole, single throw @ 115 V ac

Tom Hart WA1JGG
730 Gay St.
Westwood MA 02090

Drake Touchtone Review

-- dial as you drive

One of the most useful accessories for your 2m FM rig is a touchtone™ pad for use while operating mobile. A lot of repeater groups have installed touchtone functions ranging from telephone dialing to direct weather reports. Recently, the Drake Company introduced a new mike with a built-in touchtone pad that should be of considerable interest to many amateurs. The mike is specifically designed for use with the Drake TR-33, but can be used with other gear that is compatible with a 500 Ohm, dynamic microphone.

The feature that makes the Drake mike so interesting is that you can turn it over and tap out a telephone number from your car. What's more, the physical dimensions are only 6.6 x 8.9 x 4.3 cm (2.6" x 3.5" x 1.7"), which makes it just about the same size as a regular microphone.

The Model 1525 specifications are pretty impressive. The frequency response is 300-5000 Hz. The encoder audio level is internally adjustable from 1 mV to 5 mV and is factory adjusted for Drake gear. Finally, the supply voltage requirements are 7.5 to 15 V dc.

After receiving the mike, I had to rewire the panel socket on my Drake TR-22C. The adjustments took about one hour and involved providing the necessary voltage to pin number 4 of the panel jack along with relocating a ground connection. On a TR-33 no rework is required; just plug in and it is ready to go.

On-the-air performance has met all of my expectations. The audio quality has been found to be comparable to the original mike. The tones were tested and found to be on the correct frequency and at the proper level. I had no trouble accessing my local repeater on the first try.

The mike has interested a number of local amateurs who want a microphone and touchtone combination but don't want to build a kit. At $49.95, I think that Drake has a real winner. ■

Jim Keesler K8EXF
3233 Ash Street
Kalamazoo MI 49001

Marine Radiotelephone Conversion

-- remember the 80-D?

Photos by K8LKC.

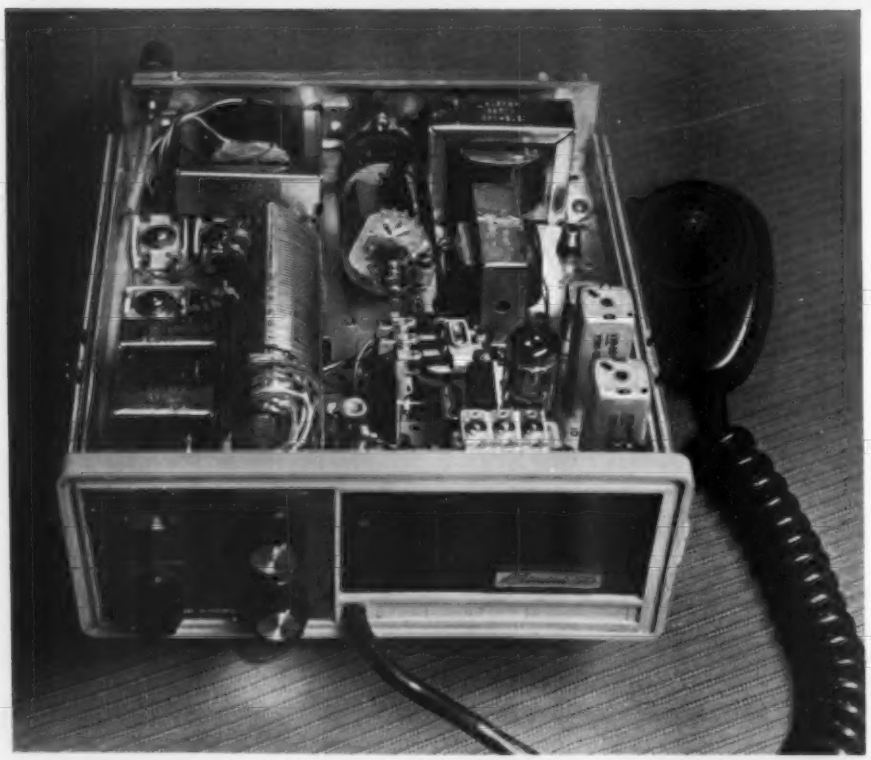


Fig. 1. The author's BIMINI 30 with top cover removed. This 30 Watt three channel model is one of several Pearce-Simpson AM marine radio telephones.

Would you believe a 50 Watt AM transceiver for 160 or 75 meters – or a CW transmitter – or a 12 to 375 V dc solid state inverter – or a dandy collection of parts for your junk box – for $20 more or less? Hard to believe in this age of inflation, but read on . . .

This year marked the end of AM operation on the 2 MHz marine band (which includes that venerable 2182 kHz calling and distress channel) in the U.S., with marine radio shifting to their new VHF FM band. Boat owners now find their AM radio telephones useless and may junk them if a ham doesn't get there first! Some rigs have already been deep sixed, so you had better act fast if you want one.

This article is based on my experience with Pearce-Simpson units used by many pleasure and business boaters on the Great Lakes. They are similar in size to 2m FM transceivers, designed for 12 V dc and draw half an Amp on receive and up to 17 Amps on transmit. The receivers are

solid state except for the rf/converter stage which is a tube for protection against static picked up by the tall boat antenna. The transmitters are two tube oscillator-power amplifier type using a 12JB6 final with a solid state modulator and run 25-50 Watts input power with plate modulation.

Both transmitter and receiver are crystal controlled and FT-243 holders work fine. The receive crystal is 455 kHz above the desired frequency. Various models have three to five channels, and some include a standard broadcast receiver. A switch allows monitoring with transmitter filaments off to save power. You may find a carbon push-to-talk microphone or telephone type handset. A pilot lamp indicates relative rf output ("tune for maximum brilliance") and a 0.635 cm (¼ inch) phone jack is on the back for checking final cathode current.

The transmitter output circuit is a pi-network plus a large loading coil in series with the antenna terminal, designed to load short vertical antennas below their resonant frequency. (A typical boat antenna is a vertical mast about 6 meters high with at least its upper half being a helical coil.)

The channel switch not only selects the receive and transmit crystals, but also selects individual plate tuning capacitors and taps on the plate and loading coils for each channel. Thus all tuning is preset. Some models have a front panel rotary switch connected to the first twelve turns of the loading coil for a fine tuning adjustment.

Most of the wiring is point-to-point and easily traced if you can't get a schematic. The channel selection wiring to the crystal sockets, tuning capacitors and coil taps is all color coded (Ch. 1 is brown, 2 is red, 3 is orange, 4 is yellow ... recognize that code?). Some units have the receiver i-f and audio on a circuit board.

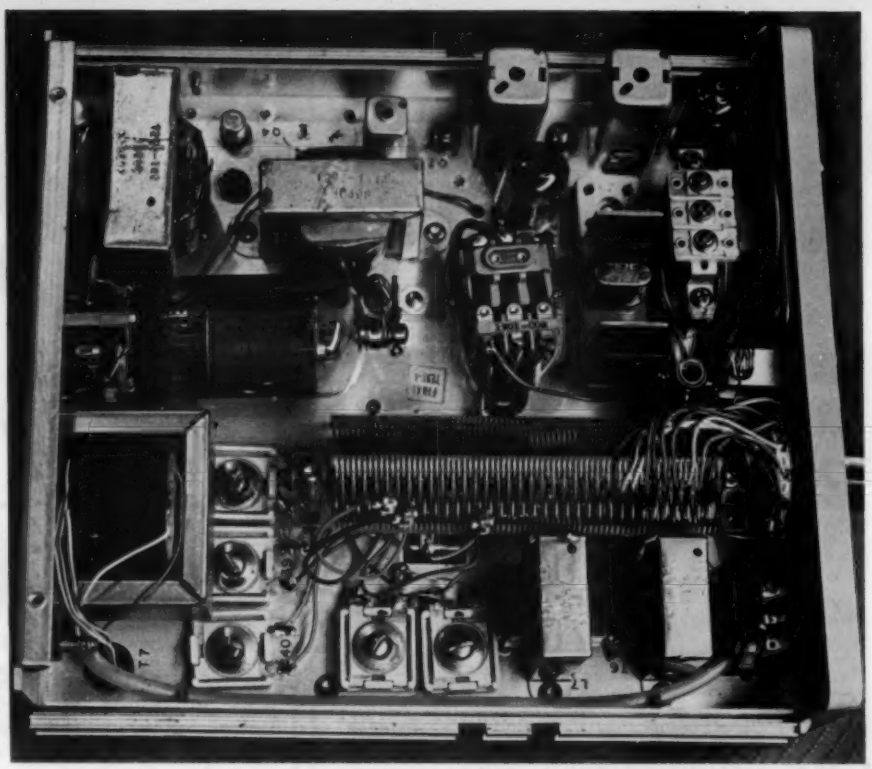


Fig. 2. Top chassis view of the BIMINI 30. The compression capacitors C38, 39 and 40 are the plate tuning capacitors for the three channels. The paralleled antenna loading capacitors are seen at the lower center with the series antenna loading coil above them. A ferrite bar inside the coil increases its inductance. The receiver section is along the top of the picture with the receiver's rf trimmers mounted above the speaker. From left to right across the center of the picture are the 12JB6 final, T-R relay, crystal sockets, receiver converter coil and the rf output indicating lamp assembly.

No Modification Needed

Now — how can we use these rigs? For openers, just change crystals, retune, and you are all set for 160 meter AM, base or mobile. If you use a car battery for your 2m FM rig in your shack, you are all set for power — just charge it more often! These rigs are great for party line operation with your friends. Here in the Kalamazoo area, we use 1985 kHz and reduce the power to 25 Watts (the maximum nighttime power for this segment in Michigan). Even with modest antennas we can reach several states and have even heard complaints from a tight-knit group in zero-land for using "their" frequency!

Best results will be obtained with a vertical antenna (top or continuously loaded) with plenty of radial ground wires. Check various antenna books for more information. However, a single wire not exceeding one quarter wavelength and run as vertical as possible will load and work over short distances. If your lowband dipole has a parallel conductor feedline, just tie the two conductors together and use it as your antenna. The ground system is very important. Use several ground rods connected together or a water pipe if you have nothing better, and keep the effective ground lead as short as possible. In technical terms, the antenna load must have low resistance and any reactance present must be capacitive to be loaded with the original tuning setup. Other loads would require external tuning devices.

Heat Up Your Soldering Iron

Now for some easy modifications. Like CW? Disconnect the +12 V dc feed to the modulator, short the modulation transformer secondary and plug a key in the meter jack. Remember this old-fashioned cathode keying method puts the B+ on your key when it is up! You can build a simple 455 kHz BFO for the receiver.

How about 80 meter CW? Use a receive crystal 455 kHz below the desired frequency and open the receiver trimmer capacitor. Some of the original receive crystals may be usable here; just add 455 kHz to the crystal frequency and see if it is in the band. Use an 80 meter transmit crystal and tap up on the plate coil.

Don't like crystals? Build a simple vfo.

Fig. 3. Rear and bottom view of the BIMINI 30. From left to right across the rear panel are the modulator transistors, meter jack, B+ inverter transistors, 12 V dc lead and the antenna binding post. The final plate coil is seen beneath the chassis across the end of the channel selection switch.

Still not satisfied? Remove everything except the B+ inverter and build whatever you like!

Where To Find Them

See your boating friends or marine radio dealer. While bargaining, remember that AM on the 2 MHz band is of no further use to the boater. While you are at it, try to get the HF boat antenna. It makes a good vertical if you put some ground radials under it. Don't wait, however — these rigs may not be kept by their owners very long.

If you cannot find a rig locally, send an SASE for information on what I have available or know about. A dollar will bring you copies of schematics, tuning procedures and other information. I would also be interested in hearing about your experiences with these little gems. Please mail all requests for information to PO Box 2664, Kalamazoo MI 49003. ■

Richard A. Watson W1ZOA
41 Harvest Street
Lynn MA 01902

Solder Soldier

- - sniff your heart out

Here is a handy gadget for picking up solder from a printed circuit board when you are trying to remove a component or excess solder. There are commercial solder removers available for about five dollars that are easier to use, but unless you need one quite often, this one works fine.

The large end is turned on a lathe to fit inside the metal tube on the end of the XYL's vacuum cleaner hose. A bit of plastic electrician's tape will hold it there.

When you are ready to remove the solder, put the tip near the solder and melt it with the iron. Put your finger over the 3/8" hole and the suction will remove most of the solder. If the solder sticks to the inside of the 3/16" hole, you can dislodge it with a nail.

The material was teflon, but you can use any plastic that will not melt if you accidentally touch it with your iron. ■

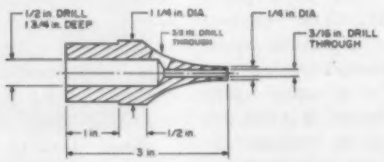


Fig. 1.

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2427 Clark Drive
LaMarque TX 77568

When the Lights Go Out

- - prepare yourself

There is always a "hurricane season" in the future, so it is never too early to consider proper preparations.

Persons who have experienced severe hurricanes have greater respect for the threat, and more generally comply with warnings and evacuation advisories. A survey immediately following Hurricane Camille (1969) found that those who evacuated comprehended the danger of a storm surge much better than did those who stayed behind.

It is difficult to comprehend the magnitude of a hurricane disaster without having had personal experience with disasters. The "voices with experience" are strangely ignored, and the volumes of statistics and warnings do not "sink in."

As the years increase since the last major hurricane, respect for the storm and the flooding grows more dim. The influx of people into the area who have no personal experience of hurricanes further dilutes the "voice of experience," and warnings now fall on "deaf ears."

More disturbing is an emerging pattern which suggests that our society is fast losing its resilience and its ability to deal with the long-term dislocations and frustrations of a natural catastrophe.

This is demonstrated in the sharp increases in alcoholism, anxiety, depression, and other emotional problems following recent natural disasters across the nation, and around the world. We are facing a mental health crisis.

This spreading pattern of maladaption to disasters, and the ignoring of potential disasters, is spreading like a cancer across the face and mentality of the nation.

What can be done to prepare the community and nation to meet widespread natural disasters? We know natural disasters are on the increase — earthquakes, tornadoes, floods, landslides, blizzards, hurricanes. One of these, as a major disaster, will strike in our community within the next few years.

We are getting better at predicting certain disasters, and hurricanes are the most accurately predicted and followed of any natural disaster. But does this prediction help? If we do not study and understand proper preparation and planning, all the warnings and predictions are useless.

A policy of maximal information, and responsible and visible community leadership, is a top priority item. Without appropriate leadership, our disaster preparations themselves will be a disaster. The role of radio amateurs is generally not that of "leader," but that of "communicator for leaders."

Home preparation must be integrated with community preparation, and community preparation must be coordinated with society as a whole. Mental preparation is even more essential than physical preparation if we are to survive as a society when the next major disaster strikes.

Perhaps the two greatest factors to produce casualties in a disaster are inertia, both individual and governmental, and the mental attitude of "if we ignore it, it will go away," and "it won't happen here."

Disaster planning in its current stage of development to a large extent is based upon civil defense plans for nuclear attack, or a minor modification of these plans. This type of planning, and thinking, is diametrically the opposite of planning for natural disasters.

Plans for nuclear attack preparedness assume that outside help would not be available (because the whole country would be stricken) and evacuation would not be feasible. Natural disasters are rather localized, and outside help would be available if planned for properly; evacuation before and after a natural disaster is feasible if there are places nearby that are not affected by the disaster.

A recent survey (1971) following a natural disaster issued a set of six recommendations for local government agencies. Some of these recommendations could apply to amateur radio, and to us individually.

1. *Local governments should establish emergency operating centers in the event of a serious disaster.* These should not only be established, but also thoroughly tested periodically. Who will man the center? How will the families be cared for if a person is at the center?

2. *Local governments should ensure the existence of emergency communications for any foreseeable emergency.* Without "eyes and ears" to gather information, and without a "voice" to communicate with sources of help, the emergency coordinating center is dead. These lines of communication should also be tested periodically.

3. *Local governments should evaluate and update plans, procedures, and preparedness measures.* An extension of this would be that these plans and procedures should be conveyed to the public in adequate time; don't wait until a disaster strikes before informing the public what to do.

4. *Provisions should be made to improve interjurisdictional coordination in future disasters.* This is a big problem in many areas, with each jealous jurisdiction wanting to do it "his way," or he won't cooperate with the other jurisdictions. We must all work together to help one another, and, with knowledge and forethought, make area plans. A hurricane, for example, does not strike an isolated jurisdiction and stop at the boundaries of that

jurisdiction, but affects a wide area and knows no political boundaries.

5. *Officials should develop a country-wide emergency transportation plan.*

6. *A study should be undertaken to ascertain the best disaster communication system.*

What can we as radio amateurs do to prepare for a disaster, and to aid in a disaster? One of the mandates of amateur radio is to be a source of communications in case of disaster or emergency.

Our area of competency is communications, particularly during and after a disaster. Before a disaster, commercial radio and TV, we assume, adequately communicate with the public, and public service radio is adequate. During and immediately after a disaster, much of the "eyes, ears, and voice" of the community will have been lost. Amateur radio will have to step in with mobile and portable communications to fill this loss of the other services.

What can we as amateurs do to prepare for and meet our obligations? (Incidentally, in making our preparations, we also improve our own mental attitude, which in turn helps the community.)

Two basic areas of preparation must be considered – our communications equipment, and how we are going to live in the disaster area.

We must assume we will have to bring our equipment, including power, and our food and lodging from outside the disaster area into the area. We should be "self-contained" to operate for at least five days. This means all of our own food, water, and lodging, and our equipment – antennas, rigs, power, and spare parts. We should coordinate with local authorities before, during, and after the disaster.

Communications Equipment

Although solid state equipment is more difficult for the average amateur to work on than is tube-type, it is more reliable and requires less power than does the tube-type.

Except in really isolated areas where "long haul" is needed from the disaster area, I would not recommend taking HF equipment into the area. In 1970, this recommendation would have been otherwise, as the nation was not so well covered with VHF capability.

Utilizing a battery, trickle charger, and a well-filtered power generator provides a well-filtered power source and steady power to the rig. The rig should be capable of working off a 12 volt battery. The new "sealed batteries" would provide an excellent source of power, and eliminate the danger of spilling battery acid.

Since disaster areas are rather localized, and we now have a large repeater network, two meters would be the equipment of choice for going to a disaster area. CB clubs all over the country are making preparations for providing communications in a disaster, but I believe in most areas two meters would give better coverage. Although 10 Watts output would probably be adequate, higher power would be better. Using a 40 Watt amplifier would not put too much additional drain on the batteries. At 10 Watts transmit power, and only a 50% duty cycle, a regular or heavy-duty car battery would probably last for several days.

Surrounding the disaster area there should be two meter stations and repeaters operating from commercial power to intercept and relay messages from the mobiles and portables in the disaster area.

Besides requiring less power, two meter equipment does not require as extensive an antenna system as does HF equipment. A Ringo-Ranger, or similar antenna, can provide up to 6 dB gain in a small antenna, and is easily mounted on a high point. Ideally, the shorter the coax run the better, but the loss with 100 feet of RG-8/U is only about 3 dB and this is more than compensated for by the antenna gain and elevation.

Why two meters instead of "220" or "450"? Mainly because there is much more two meter equipment available.

One must also consider that it would be easier to carry a spare VHF rig than it would be to carry necessary repair equipment.

Living Equipment, Supplies, and Transportation

Food, water, and lodging are scarce in disaster areas. If we do not want to be an additional drain on scarce resources, we should enter the disaster area as a self-contained unit. In some areas, officials will not let a unit enter the disaster area unless it is self-contained, or carries its own supplies.

A "high-centered," four-wheel drive, closed truck or van would probably be best for negotiating debris-strewn roads, and could go even where roads are impassable. From the standpoint of creature comfort, the self-contained motor home would be the first choice. Pickup campers and vans would be less desirable and camping trailers and travel trailers least desirable, due to problems with pulling, parking, and navigating.

Whatever your choice of transportation, there are certain basic supplies which you must carry – food, water, cooking utensils, stove, bedding, and first aid equipment.

It is always desirable to have hot food, but this means you also need cooking utensils and a stove. There are many types of camp stoves, using various types of fuel. Remember to carry the proper type of fuel for the stove which you use. Simple cooking utensils are best.

Food is a personal choice, but there are some basics to remember:

1. If you take canned food, be sure to take a can opener.
2. Highly seasoned or salty food requires more drinking water.
3. Certain foods, such as canned tomatoes, are "thirst quenchers" and reduce the amount of drinking water you need to carry.
4. Food should not require refrigeration for preservation, or you will have to worry about power or ice for refrigeration.
5. Don't carry food or water in glass containers; they might get broken.
6. Water for drinking should be not less than one-half gallon per person per day, and one gallon/person/day would be better. ■

Check-off List

- — Transceiver
- — Backup transceiver
- — Connecting cables
- — Power cable
- — Amplifier (if desired)
- — Power supply (batteries)
- — Power generator
- — Trickle charger
- — Antenna
- — Coax
- — Antenna mast
- — Mast guy lines
- — Soldering iron
- — Solder
- — Spare wire
- — Microphone and spare
- — Vehicle
- — Tow cable
- — Jumper cables
- — Car tools
- — Spare tire
- — Jack
- — Tire tools
- — Spare gas
- — Water
- — Canned food
- — Bread
- — Jelly
- — Camping stove
- — Bedding
- — Fuel for stove
- — Toilet articles

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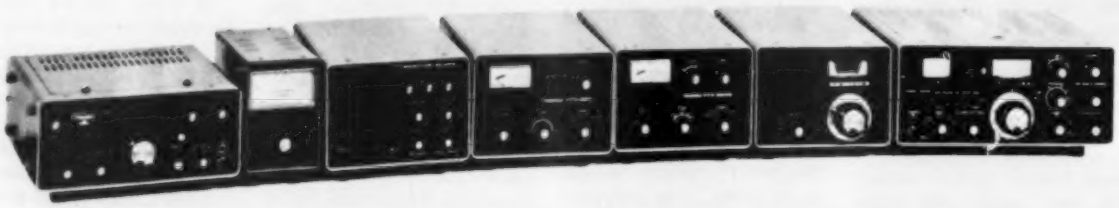
Left to right – FRG-7, Solid State Synthesized Communications Receiver • FR-101 Digital, Solid State Receiver • SP-101B, Speaker • FR-101, Digital Solid State Receiver • FL-101, 100 W Transmitter • FL-2100B, 1200 W PEP Input Linear Amplifier



Left to right – FT-620B, 6 Meter Transceiver • YP-150, Dummy Load Wattmeter • YO-100, Monitor Scope • FTV-250, 2 Meter Transverter • FTV-650, 6 Meter Transverter • FV-101B, External VFO • FT-101E 160-10 M Transceiver

Left to right – YC-601, Digital Frequency Display • YC-355D, Frequency Counter • FP-301, AC Power Supply • FT-301S Digital, All Solid State Transceiver • FV-301, External VFO • FT-221, 144-148 All Solid State All Mode Transceiver

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TR-7400A **$399.00**

2M MOBILE TRANSCEIVER. Synthesized PLL. Selectable output, 25 watts or 10 watts. 6 Digit LED freq. display. 144-148 MHz, 800 CH. in 5 KHz steps. 600 KHz repeater offset. Continuous tone-coded squelch (CTSC). Tone Burst.

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Optional external speaker for better readability.

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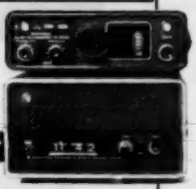


PS-5 **$79.00**

DYNAMIC MICROPHONE. Designed especially for homes. PTT and lock switches. 600 or 50K ohm.

TR-7200A **$249.00**

2M MOBILE/BASE FM TRANSCEIVER. Ignition interference control. 2 pole Xtal filter in IF rcvr. Protection for final stage transistor & reverse polarity connections. Priority Ch. switch. Quick release mount. LED CH. indicators. Switchable 10W or 1W output.

MC-50 **$39.50**

Dynamic microphone designed expressly for amateur radio operation. Complete with PTT and LOCK switches, and a microphone plug. (600 or 50k ohm)

COMMUNICATIONS RECEIVER. 1.8 to 29.7 MHz, WWV and CB band. 50 MHz, 144 MHz converter optional. Stable VFO & oscillator for 5 fixed channels. 1 KHz dial readout. Xtal filters (SSB/8 pole, CW/8 pole, AM/6 pole). Squelch. S meter. Noise blanker.

S-599-$19.94 R-599A-$459.00 T599D-$479.00

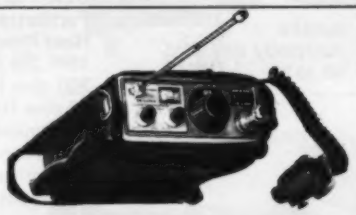
SSB TRANSMITTER. 3.5 to 29.7 MHz. Stable VFO. 1 KHz dial readout. 8 pole Xtal filter. AM Xmission available. Built-in AC pwr supply. Split frequency control available.

VFO-820 **$145.00**

Designed exclusively for use with TS-820. RIT circuit and control switch. Fully compatible with optional digital display.

VFO-520 **(Not Shown)** **$116.00**

Solid State Remote VFO. RIT circuit with LED indicator.



TR-2200A **$229.00**

PORTABLE 2M FM TRANSCEIVER. 12 Ch. capacity. Removable telescoping antenna. External 12 VDC or internal NI-CAD batteries. 146-148 MHz. 6 CH. supplied. Switchable 2W or 400mW output.

R-300 **$239.00**

ALL BAND COMMUNICATIONS RECEIVER. AC, batteries or external DC. 170 KHz to 30 MHz in 6 bands. Foreign broadcasts or ham radio in AM, SSB and CW. Dual gate MOS/FET transistors & double conversion. Band spread dial. 500 KHz marker.

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4NB	Noise Blanker for R-4C	$52.00
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TRANSMITTER

T-4XC	C-Line. HF. 160-10M	$599.00

TRANSCEIVERS

TR-4CW	80-10M. SSB, AM, CW	$649.00
TR-33C	2M, FM, 12 CH. Portable	$229.95
MMK-33	Mobile/Dash/Desk Mount for TR-33C	$12.95
34PNB	Plug-In Noise Blanker for TR-4 Series	$100.00
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WV-4	RF Wattmeter, 20 to 200 MHz	$84.00
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7075	Desk Top Microphone	$39.00
1525EM	Pushbutton Encoding Microphone	$49.95
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AA-10	10W, 2M Amplifier	$49.95
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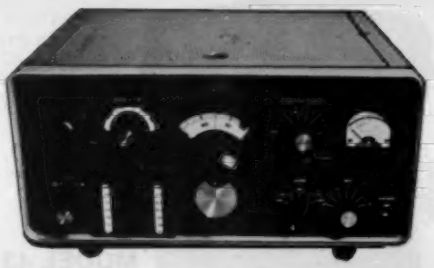
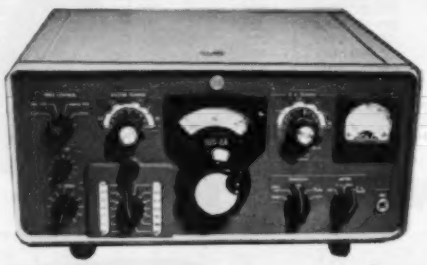
Unmatched for mobile and fixed station applications. 175W on SSB, 160W on CW. Switch select up to 14 optional Xtals. Can be used for RTTY. Filter type SSB generation. Automatic load control. Inverse RF feedback. Reimeability-tuned variable oscillator.

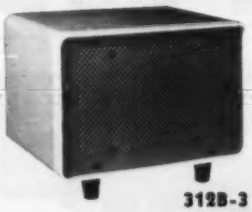


75S-3C RECEIVER **$2504.00**
Sharp selectivity. SSB, CW and RTTY. Single control rejection tuning. Variable BFO. Optional mechanical filters for CW, RTTY and AM. 2.1 KHz mechanical filter. Zener regulated oscillators. 3-position AGC.

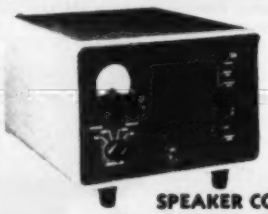


32S-3A TRANSMITTER **$2597.00**
Covers all ham bands between 3.4 MHz and 30 MHz. Nominal output of 100W. 175W, SSB and 160W CW. Dual conversion. Automatic load control. RF inverse feedback. CW spotting control. Collins mechanical filter.

30L-1 LINEAR AMPLIFIER **$1536.00**
1000 watts PEP on SSB and 1000 Average on CW. Single control rejection tuning (50 dB). Variable BFO. 2.1 kHz Mechanical filter. Zener regulated oscillators. 3 position AGC. Exclusive comparator circuit.

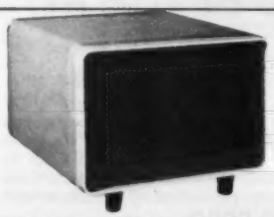


312B-3 SPEAKER
$80.00



312B-4
SPEAKER CONSOLE
$546.00

312B-5 VFO CONSOLE
$1212.00



516F-2 AC POWER SUPPLY
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302C-3 DIRECTIONAL WATT METER
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Table 1
STANDARD ELEMENTS

Power Range	Frequency Bands (MHz) 2-30	25-60	50-125	100-250	200-500	400-1000
5 watts	—	5A	5B	5C	5D	5E
10 watts	—	10A	10B	10C	10D	10E
25 watts	—	25A	25B	25C	25D	25E
50 watts	50H	50A	50B	50C	50D	50E
100 watts	100H	100A	100B	100C	100D	100E
250 watts	250H	250A	250B	250C	250D	250E
500 watts	500H	500A	500B	500C	500D	500E
1000 watts	1000H	1000A	1000B	1000C	1000D	1000E
2500 watts	2500H					
5000 watts	5000H					

Table 2
LOW-POWER ELEMENTS

1 watt	Cat. No.	2.5 watts	Cat. No.
60-80 MHz	060-1	60-80 MHz	060-2
80-95 MHz	080-1	80-95 MHz	080-2
95-125 MHz	095-1	95-150 MHz	095-2
110-160 MHz	110-1	150-250 MHz	150-2
150-250 MHz	150-1	200-300 MHz	200-2
200-300 MHz	200-1	250-450 MHz	250-2
275-450 MHz	275-1	400-850 MHz	400-2
425-850 MHz	425-1	800-950 MHz	800-2
800-950 MHz	800-1		

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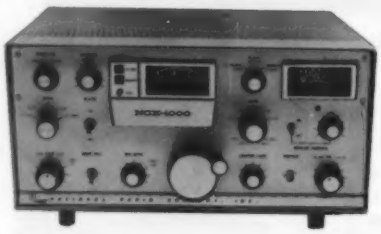

NCX-1000

The only 1000 watt, "single package" transceiver. Heavy duty design . . . results of 50 years of design leadership in amateur equipment. State of the art speech processing, linear amplifier, power supply, all in one package. Nothing extra to buy. Covers all amateur bands in the HF spectrum . . . AM, SS' CW' **$1,600**

NCL-2000

Linear Amplifier. A full 10 dB gain. 20 watts in 2000 watts out. Can be driven with one watt. Continuous duty design utilizes two 8122 ceramic tetrode output tubes, designed for both AM and SSB operation. The industry standard for 12 years. Thousands in use all over the world.

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HRO-500

The ultimate short wave receiver. This synthesized (phase lock loop) receiver incorporates all facilities for AM, Single Side Band (SSB), and CW receiption in all frequencies from the bottom of the very low frequency band (VLF) to the top of the high frequency band (HF). National's "dead accurate" dial means no searching for transmissions. Dial up the frequency and it's there: aeronautical, marine, CB, amateur, military, etc. Continuous coverage.

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IC-245. 146 MHz FM 10W XCVR. LSI synthesizer with 4 digit LED readout. Xmit & Rcv frequencies independently programmable. 60 dB spurious attenuation.
$499.00

IC-215. 2 METER FM PORTABLE. Three narrow filters for superb performance. 3W or 400 mW. 15 CH. capacity. MOS FET RF Amp & 5 tuned ckts. S-meter front panel.
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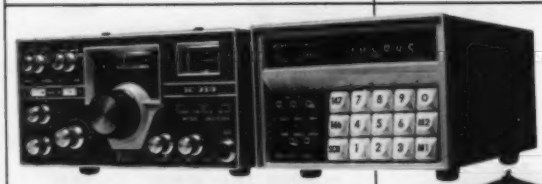
$249.00

IC-502. 6 METER SSB & CW PORTABLE XCVR. Includes antenna & battery pack. 3W PEP & stable VFO for fun & FB QSO's. Covers first 800 KHz of 6M band, where most activity is.

IC-211. 4 MEG, MULTI-MODE 2M XCVR. 144-145 MHz on SSB & CW, plus 146-147 MHz on FM. Work AMAT OSCAR six or seven. LSI synthesizer with 7 digit LED. MOS FET RF Amp, 5 helical cavities, FET mixer & 3 I.F. filters.
$749.00

$299.00

IC-22S. 145 MHz FM 10W XCVR. CMOS synthesizer can be set to any 15 KHz ch. between 146 & 148 MHz by diode matrix board. Spurious attenuation far better than FCC spec. 10W or 1W. IDC modulation control.



IC-21A. 146 MHz FM 10W XCVR. MOS FET RF Amp & 5 helical resonator filter, plus 3 I.F. filters. IDC modulation control. Variable output pwr: 500 MW to 10W Front panel discriminator meter. SWR bridge. 117 VAC and 13.6 VDC pwr supplies.
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DV-21. DIGITAL VFO. Use with IC-21A to complete 2M band.
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IC-202. 2 METER SSB PORTABLE XCVR. Puts sideband in your hand! Internal C batteries or external 12 VDC. 3W PEP. True I.F. noise blanker. 144.0, 144.2 on two other 200 KHz bands, selectable. Hamtronics stocks 145.2 and 145.8 · 146.0 MHz for calling frequency & satellite band.
$259.00

IC-30A. 450 MHz FM LOW XCVR. 1W or 10W. Low noise MOS-FET RF Amp & 5 section helical filter. 22 CH. capacity. S-meter & relative power output meter. IDC modulation control.
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TEMPO ONE	HF Transceiver. 80-10M. USB, CW & AM	399.00
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VF/ONE	External VFO for TEMPO ONE	109.00
TEMPO VHF/ONE	Transceiver. 2M. 144 yo 148 MHz. PLL	399.00
TEMPO SSB/ONE	SSB Adapter for TEMPO VHF/ONE	199.00
TEMPO 2020	Transceiver. 80-10M. USB, LSB, CW and AM. PLL. Digital	759.00
FMH	2W, VHF/FM, 6 Ch. Hand Held. 144-148 MHz	199.00
RBF-1	Wattmeter & SWR Bridge	42.95
DM-20	Desk Mike. 600 or 50K ohm. PTT & Lock Switches	39.00
MS-2	4 Ch. Pocket Scanning Rcvr.	99.00

ATLAS

210X	Transceiver. 10-80M. 200W	679.00
215X	Transceiver. 15-160M. 200W	679.00
OMK	Deluxe Mtg. Kit for 210X & 215X	48.00
220CS	AC Console for 210X & 215X	149.00
350-XL	Transceiver. SSB. Solid State. 10-160M. 350W.	995.00
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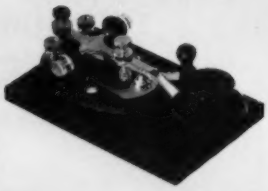

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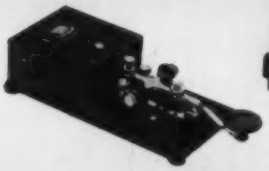

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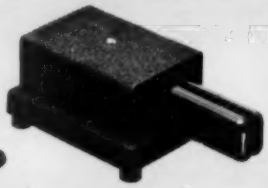

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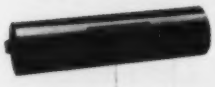

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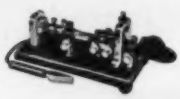

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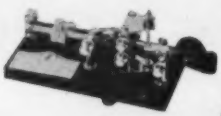

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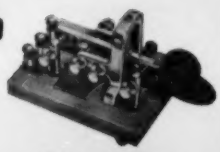

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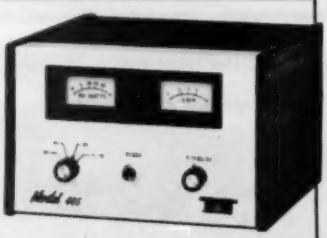

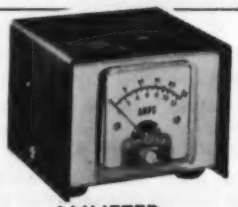

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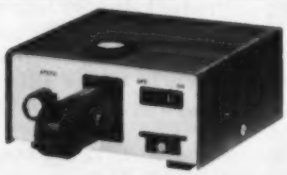

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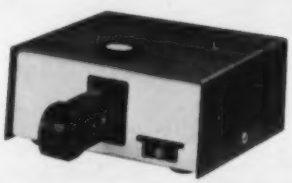

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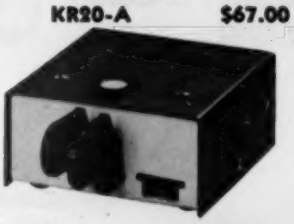

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Ten-Tec Mods

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The Ten-Tec Argonaut has proven itself to be a reliable high performance rig, ideal for portable/emergency as well as fixed station use. Even so, there are several modifications that can make the Argonaut more enjoyable to use.

Relocation of Drive and Mike Gain Controls

One of the major aggravations in operating the Argonaut is the placement of the important drive and mike gain controls on the back panel, while the relatively useless meter sensitivity control is on the front panel. If the drive control were easily reachable so that it could be turned down while the resonate control is peaked, there would be no need to desensitize the meter.

Fortunately, it is a relatively simple modification to move the drive and mike gain controls to the front panel by replacing the meter sensitivity pot with a dual concentric 25k pot. The procedure is as follows:

NOTE: These instructions assume that Ten-Tec has always used the same color coding in the wiring harness. Since this may not be the case, protect yourself by tracing the wiring to R14 and R16 and making notes of the colors and locations of each wire before disconnecting any of them.

1. Remove the knobs, top and bottom covers, end pieces, and false front panel.

2. Remove all of the plug-in circuit boards, but before doing so, take a Sanford Sharpie or other fine point, non-watercolor, marks-on-anything marker and put an "F" on each board on the end closest to the front panel to avoid getting them in backwards during reinstallation.

3. Remove the meter sensitivity pot from the front subpanel. Tack solder a small 25k trimpot to the back of the meter switch where the wires from the sensitivity pot attach and discard the old wires.

4. Remove the nuts from the mike and speaker/phone jacks and swing them out of the way. Unsolder the wires from the drive and mike gain pots. Remove the pots from the back panel and fill the holes with 3/8" hole plugs (such as Radio Shack #21-920). Replace the mike and speaker/phone jacks.

5. The wires for the mike gain control all originate on the top of the chassis at the rear socket for the sideband generator/filter board. Pull them through to the top of the chassis and twist them together for identification.

6. The 2 grey and 1 white wire from the drive control should be fed to the top of the chassis through the same grommet that the mike gain wires were just pulled through.

7. The yellow wire that went to the drive pot connects to the bias pin on the socket for the rf power amp board. Remove the yellow wire and solder a new longer one to the bias pin. Feed the new yellow wire up through the space in front of the rf front end box and then route it along with the existing bundle of wires that runs along between the rf front end and VFO and then goes down behind the VFO and under the edge of the TX-RX mixer board.

8. Now that all of the wires for the two pots are in the correct general area, route them next to the chassis between the front sockets for the control board and the sideband generator/filter board and on over to where the pot will mount.

9. Dress the wires, trim them to length, and solder them onto the dual pot. (It is easier to wire the pot before it is mounted on the subpanel.) Refer to Fig. 1 or to the notes you made earlier for correct placement of the wires. Bend the resistor protruding from the side of the meter switch 90° out of the way and mount the dual pot on the subpanel. At this time, the 22k resistor (R15) associated with the drive control

View of front panel after modification, showing new dual drive and mike gain control. The main tuning knob with spinner is the one used on the Triton IV and is a direct replacement for the Argonaut knob. The Triton knob is available from Ten-Tec for $1, postpaid.

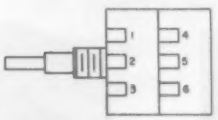
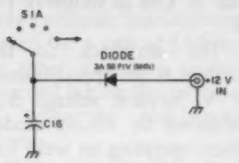


Fig. 1. Wiring the dual pot. Mike gain: 1. Yellow wire from sideband generator rear socket, pin 2; 2. Green wire from sideband generator rear socket, pin 3; 3. Black wire from ground lug near sideband generator rear socket. Drive: 4. 2 grey wires (1 from wiper of S3B, 1 from R13), 1 yellow wire from rf amp, pin 5; 5. White wire from S3B, contacts 2 and 4; 6. R15 to ground.

Fig. 2.



can be grounded to the pre-existing lug near the edge of the chassis. The dual pot that I used was a Centralab Fastach® II series snap-together unit consisting of an F1-25K and R1-25K, both taper C-1 (linear taper) and suitable snap-in shafts.

10. Double check your wiring. Replace the circuit boards, being careful to put them in the right way, and fire up the rig to check it out. Ensure that you have the pots wired so that clockwise is the increasing direction. Adjust the meter sensitivity trimpot to give a full scale reading at the rated power output.

11. Replace the covers and knobs. This completes the modification.

Reverse Polarity Protection for the Argonaut

With care, a reverse polarity accident need never happen. However, anyone can have a bad day now and then, and enough Argonaut owners have blown up their rigs with reverse polarity that Ten-Tec has a pre-packaged kit that includes replacements for everything that pops when the Argo is powered up backwards.

There are two approaches to reverse polarity protection. The quick and dirty way is to install a silicon rectifier diode between the center pin of the power jack and the junction of C44 (1000 uF 16 V) and the black wire. The diode should be conservatively rated (3 A 50 piv will do) and installed with the cathode

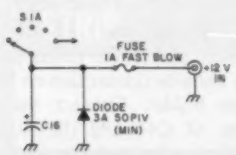
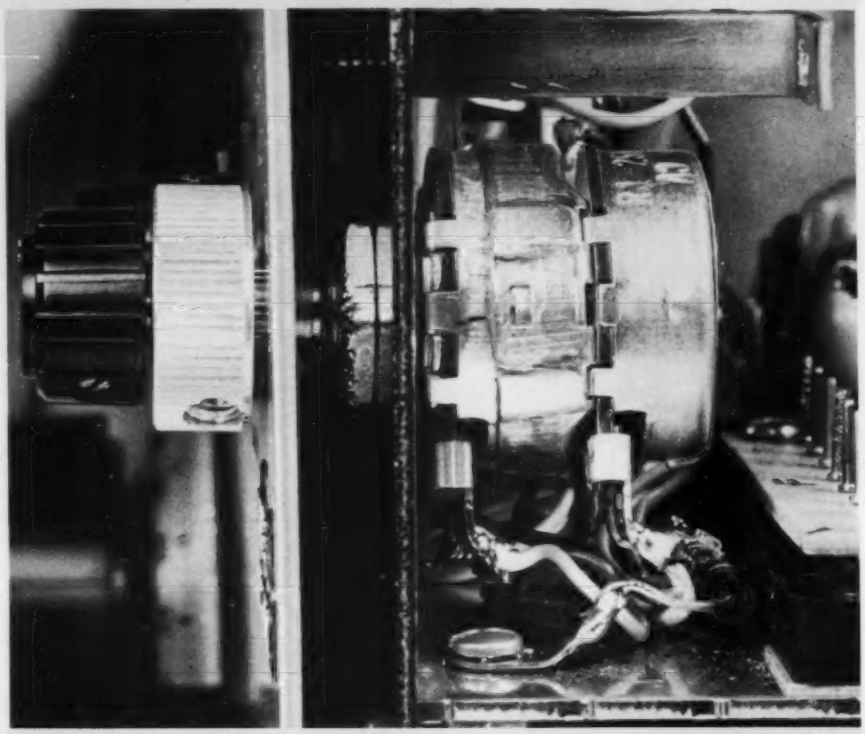
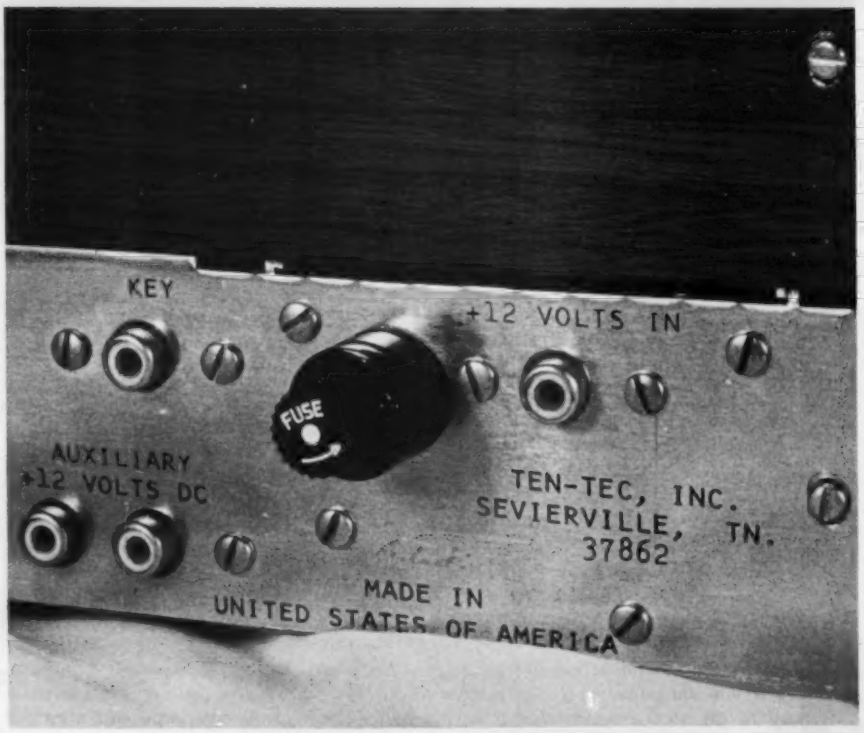


Fig. 3.

Detail showing the dual pot after installation. As can be seen, there is plenty of room for the larger pot. The solder lug at center bottom is factory installed and provides a perfect place to ground R15.





Rear panel view showing the location of the fuse post.

Argonaut speaker as modified by homemade "L" bracket and 2 pin plug and socket set (Radio Shack #274-342), allowing cover to be detached for added convenience while working on rig.

A good low resistance connection to a car battery being used as a power supply is important, especially if you are powering a high current load device such as the Ten-Tec 405 Linear. A good way to get such a connection is with a battery post clamp with stud and wing nut terminal. Shown here is a Belden #7495 from a NAPA auto parts jobber. A similar item is available in the Sears catalog.

(banded) end toward the + side of C44 as shown in Fig. 2.

The drawback to this method is the approximately .7 V forward voltage drop exhibited by silicon diodes. When operating on weak batteries or other marginal power sources, this voltage drop could cause chirp or loss of VFO voltage regulation.

A better approach, offering more protection to the rig, is the method used in the Model 405 linear and other models in the Ten-Tec line. The power lead is fused and the fuse is followed by a reverse biased diode between + and ground, as shown in Fig. 3. Under conditions of correct polarity, the diode has no effect, but if polarity is reversed, the diode conducts heavily and blows the fuse.

It would be possible to install the diode inside the rig and make up an in-line fuse power cord, but a neater installation results from the use of a panel mount fuse holder. The space available for mounting is tight, so select a fuse holder that does not stick too far behind the panel (a Radio Shack #270-364 is satisfactory). The mounting location is slightly to the left of the power jack. It will be necessary to remove the top and bottom covers and the end piece closest to the power jack. Also, remove the screw that holds the receiver output trimmer strip and swing the strip up out of the way.

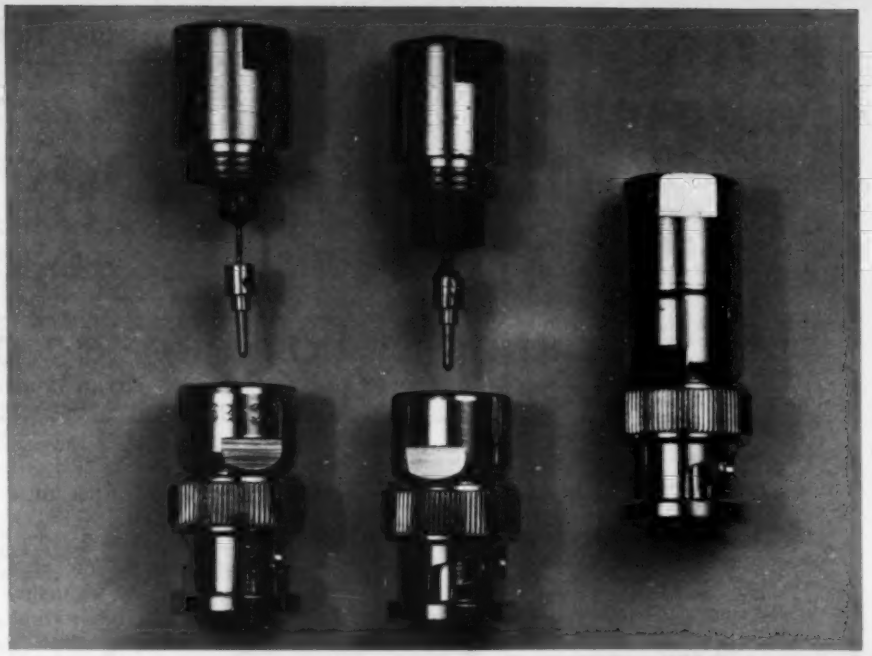
A ½" hole is needed for the fuse holder. Use of a Greenlee punch will minimize the amount of metal chips that fall inside the rig. You may have to snip the edge off the bakelite plate on the power jack to provide clearance for the fuse post.

Run a wire from the center pin of the power jack to the side connection on the fuse holder. Connect the + side of C44 and the black wire to the end connection on the fuse post, and place

the diode (at least 3 A 50 piv) in parallel with C44. The diode's cathode (banded) end goes to the + side of C44 and the other end goes to the grounded lug on the terminal strip where the - end of C44 grounds.

Shake out the drill chips and swing the trimmer strip back down and replace its screw. Check to make sure that none of the bare wires from the trimmer strip are shorted to each other or to anything else. Reinstall the covers.

Put a 1 A fast blow fuse in the holder. Under no circumstances should you use a slow blow fuse; to do so might result in the diode popping before the fuse does. Since the Argonaut does not actually draw a full 1 A of current, a 1 A fuse allows enough headroom to power small, low current accessories such as an audio filter and crystal calibrator from the rear panel auxiliary power jacks. ■



Converting Kings KC-89-66 BNC Video Termination into a QRP dummy load. Left is stock unit with 75 Ohm ¼ W film resistor. Middle shows installation of 51 Ohm 2 W carbon resistor. Because of the 2 W resistor's larger lead size, it is necessary to enlarge the holes in the center pin and case. Right is assembled unit. Because of the heat sink effect of the case, the dummy load can handle up to 5 W for short periods.

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EXCEPT AS NOTED ALL A1 QSOS 100 WATTS. ALL A3 QSOS 840 WATTS.

                  TIME    EMISS    RPRT
DATE STATION START END   FREQ  HIS  MINE  OTHER              QSL
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------


AMATEUR RADIO STATION LOG FOR JAMES BERETS. WA1UOU  LOCATED IN
STAMFORD      CONN.
EXCEPT AS NOTED ALL A1 QSOS 100 WATTS. ALL A3 QSOS 840 WATTS.

                  TIME    EMISS    RPRT
DATE STATION START END   FREQ  HIS  MINE  OTHER              QSL
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------
   I       I     I    I    I     I     I                   S R
-------------------------------------------------------------------
```

Fig. 1.

After reading the article by Robert Hatch WØTBL (*73*, Holiday, 1976, page 84) on the use of a computer to print log sheets, I decided that this sort of project was one which I might pursue. Unfortunately, I do not have access to a computer using FORTRAN, haven't the foggiest notion of how FORTRAN IV works, and was reluctant to impose on people who do. However, I have just finished a half-year course in BASIC programming on the PDP-8/e and decided that this was more my speed. This final fact placed the objective within my grasp.

The program, as shown in Fig. 1, is relatively straightforward for anyone familiar with BASIC. Almost all commands in the program have been abbreviated to their three letter abbreviations. The back slashes allow more than one command to be placed on a line. Inputs are provided for the number of QSOs per log page and number of pages desired, while string variables are input for the printing at the top of each log page of name, QTH, and callsign of the operator. These inputs allow for the user's own information and allow more than one person to use the same program.

I found the elimination of a column for "power" necessary due to the fact that standard teletype paper is only 8½ inches wide. Not enough room would remain for other information if I included a column for power. Since most people usually use the same power on any given mode, I included the power designation at the top of each page for CW and voice modes. If desired, the power to be used could be entered in the "other" column.

The judicious use of semicolons, commas, and quotation marks containing a number of spaces creates the proper spacing in the page heading. This technique also extends the last name of the operator and city name to a maximum of twelve characters (string length is a maximum of six characters with the PDP-8/e).

Obviously, the most efficient way to execute the program would be on a high speed line printer. However, it would be just as easy to set the computer to its task and have it print your log book on a TTY while you sleep (if you can stand the noise).

One final note: This program is by no means hard and fast. It is readily adaptable to the whims of the user. From this basic (no pun intended) format, one could print special contest logs to accommodate for special exchanges or print a log expressly for the traffic handler. The possibilities are almost infinite. ■

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Troubleshooting A Micro

-- not as bad as it sounds!

Kenneth J. Hintz WB4KEO
222 Taylor Street
Fredericksburg VA 22401

While we are often bombarded with propaganda from Wayne Green and the manufacturers proclaiming the wonders of microprocessors and what they can do to automate our station or figure our income tax, we sometimes overlook the problems associated with trying to troubleshoot an ailing system. There is a good reason for this, based on the complexity of the functions that are being performed and the unavailability of test points within the chip. You must be somewhat of a detective to determine what is happening inside from the sparse information that is available to you externally. Fortunately, few of the problems are found within the microprocessor chip itself, but that possibility does exist. While there may be some exceptions to this, it has been my experience that, if the microprocessor will fetch and execute one instruction, it will probably fetch and execute all instructions.

Before starting the troubleshooting procedure, it is important to note whether or not the system is home brew or from a manufacturer. It is also significant whether it has been running and just died, or whether it has never run properly. While the troubleshooting that follows is applicable to all of these cases, there are certain problems that can be ruled out, depending on the previously mentioned conditions. For example, if it is a manufactured system that you are merely assembling, then it is unlikely that it is a wiring error on the cards that you have purchased. If it is your own handwired system, then the likelihood is that you've forgotten some interconnect or connected something up incorrectly.

If the system has been running but now fails, the problem can usually be traced to a faulty bus driver/receiver on the data or address bus. If the system is intermittent, look for temperature effects changing the response of memory, or look at that new interface or memory board that you just hung on the system. Much troubleshooting can be done by merely removing one memory or interface card at a time.

Before continuing, it may also be necessary to note those minimum pieces of test equipment that are required for troubleshooting a system. While some rudimentary checks can be made with a VOM, the system must be looked at dynamically with at least a 10 MHz bandwidth scope. This scope should have at least external triggering and preferably dual trace. Yes, you can look at the buses with slower scopes and see the transitions, but we are looking for problems that may be associated with 50 ns pulses of noise riding around on signal lines, and you will never see them without the prerequisite bandwidth. The microprocessor should also be set up with a hardware restart switch connected directly to the chip itself (or through a peripheral chip designed to do this), so that it can be repeatedly restarted. The reason for this will be evident in later discussion.

There is also one class of problem that is not discussed here, and that is the passing of misinformation by the manufacturer. Occasionally, errors are made in the manuals, or changes are made in the chips that cause them to not function as advertised. This, of course, pertains mostly to the

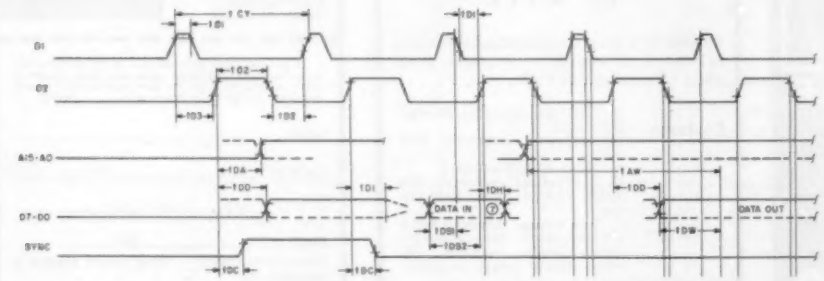

Fig. 1. Timing diagram for an 8080A microprocessor. Intel specifies tφ1 as 60 ns minimum, tCY as 480 ns to 2 microseconds, tφ2 as 220 ns minimum, tD3 as 130 ns minimum, and tD2 as 70 ns minimum.

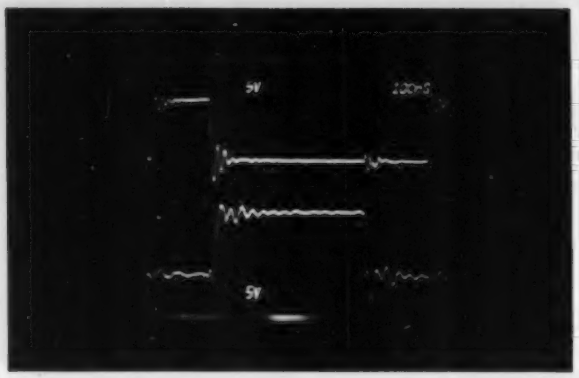

Fig. 2. Scope photograph of an 8080A's two phase clock. The top trace is phase one and the bottom trace is phase two. Note that the clocks are not TTL signals and that they meet the timing requirements as outlined in Fig. 1.

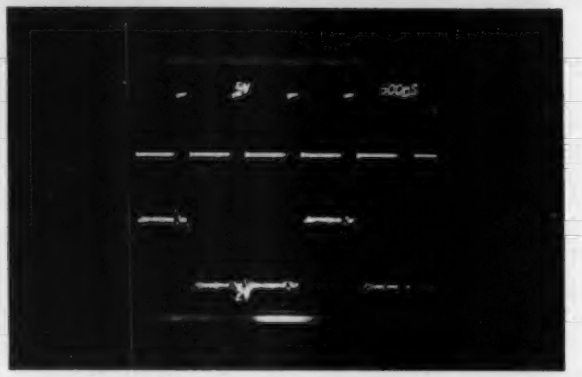

Fig. 3. Timing relationship between phase one and synch for an 8080A running at a crystal frequency of 9.5 MHz.

home brew systems. Don't be afraid to call up the local field applications engineer for the company that made the chip and explain your problem. They are, in general, knowledgeable about their product, and may have actually encountered the problem before. If it is a long distance phone call, call them before they are in the office and leave a message with their answering service to have them call you. It may save you quite a phone bill.

Enough of the boilerplate. As with all electronic problems, beware of the obvious. That is, whether it is a microprocessor that just plain refuses to work, or one that intermittently fails to execute its program properly, start with some of the basics which are often taken for granted.

Power Supply Voltages

The tolerance on power supplies is ±5%, or 4.75 to 5.25 volts for the 5 volt supply and 11.4 to 12.6 volts for the 12 volt supply. And that is a clean five/twelve volts and a clean ground line. While you wouldn't expect it, most of the digital noise that is found is on the ground line. It should be the first suspect for intermittent faulty operation, assuming that it has never yet worked completely right. Adequate current reserve in the power supply and sufficient bypass capacitors are required for proper operation. As ballpark numbers, 10 microfarads per twenty chips and 0.1 microfarad (for high frequency bypassing that the electrolytic can't handle) near each chip that drives signals off of the card or over long distances (e.g., bus drivers) should be sufficient.

Another point to remember about checking power supply voltages is to check them at least on the card, if not near the chips themselves, for two reasons. The first is that if a power supply with no voltage sensing is used, the voltage at the power supply may be set to five volts. But, because of losses due to the high currents and small gauge supply wires, the voltage at the chips may, in fact, be below the 4.75 volts minimum. Secondly, if remote sensing is used, the sense line may be open, or the regulating circuitry not operating properly.

Clocks

To operate properly, microprocessors must be supplied with clock signals, since all of the internal functions are performed synchronously. Not only must these signals be present and of the proper duration, but they also must be free from glitches and in the proper timing relationship. Fig. 1 shows a timing diagram for an 8080 showing a two-phase clock. Note that the duration of phase one must be a minimum of 60 ns, the delay between the rise of phase one and the rise of phase two a minimum of 130 ns, and the delay between the fall of phase two and the rise of the next phase one 70 ns minimum. An actual photograph of an 8080A's clock signals is shown in Fig. 2. While the clock was being run at 9.5 MHz, rather than the maximum of 18 MHz, it can be seen that the minimum times are met. A measurement like this can not only be made on a dual trace, 10 MHz scope triggered only by the phase one input, but can also be done on a single trace unit with external trigger. First, phase one is displayed and checked in terms of glitches and minimum pulse width and maximum pulse interval. The triggering is now set up for this signal, and it is moved to the external trigger input (with the scope triggered from this source). Phase two is now connected to the vertical input and displayed, relative to phase one. It may make it easier if phase one is written in on the face of the display with a grease pen.

Instruction Execution

We are now assuming that the microprocessor is hard down and won't do anything. First, disconnect all cards/interfaces/memory, except for Read Only Memory (ROM); then program a ROM with a jump-to-self instruction. In the case of an 8080, the instruction would be as shown in Table 1. It is, quite literally, Jump (C3H) to the address (0000H) which follows.

While this can be done with other instructions on different machines (such as those with program counter relative addressing), the principle is the same: Try to get the machine to do the minimal amount it can do and still keep fetching and executing a predictable instruction. Now, how do you know if it is running? Look at the synch signal out of the microprocessor. (In the case of the 8080, there is one synch per instruction execution.)

The first check, in this case, is to look at the synch (see Fig. 3) while the reset (a hard reset to the microprocessor through a switch closure) is activated. This reset should set the internal program counter to the starting address where the first instruction will be found (0000H in the case of the 8080), and the microprocessor will run for one, two, or a number of instructions and then halt. Each of these has a significance. One instruction execution (or synch pulse) means that the microprocessor recognized the reset and has gone out to fetch the first instruction from its starting address. If you don't see at least one synch, it is probably a microprocessor chip problem. If a second synch pulse is found, it means

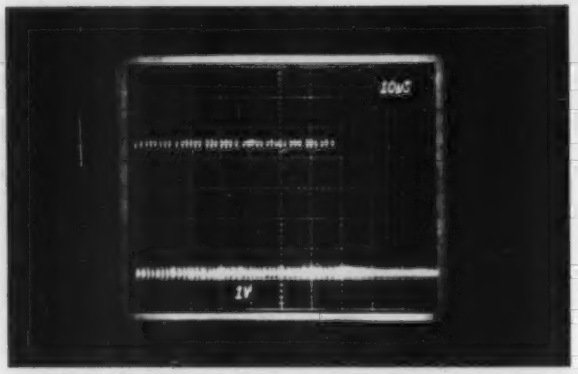

Fig. 4. Synch pulses showing the effect of a microprocessor fetching several instructions and then dying. This can be one of the hardest problems to diagnose. It is usually attributable to slow memories.

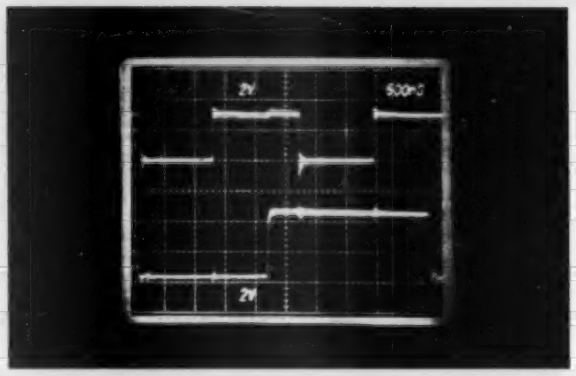

Fig. 5. The top trace is read memory bar (low is true) pulse. Address information should be stable during this time. The lower trace is an address line showing a solid zero during RM pulse one and a one during RM pulse two.

that the microprocessor has output an address, and something has come back. What you don't know for sure is what actually was read from memory. But, you do know that it is going out and fetching. If our dummy instruction is being fetched a number of times (this could be into the hundreds – see Fig. 4), and then dies, this can probably attributed to slow memories. To test for this, slow down the system clock. "How?" you say. "It's crystal controlled." First of all, there is nothing that says that it has to be crystal controlled and, second, any ham should have miscellaneous crystals around that are less than the value (preferably ½) of the crystal frequency currently being used in the system. Insert the crystal, verify that the clock is running, and see if the microprocessor still dies. If it does, we have to look further.

Address	Contents
0000Hex	0C3Hex
1H	00H
2H	00H

Table 1.

Address Bus

Whether we are at the one, two, or three or more synch pulse stage, it is advisable to check the address bus for proper operation. We are, of course, assuming that the ROM with the jump-to-self instruction is still in the system at the starting address of the microprocessor. One method of checking for proper operation of the address bus would be to synch to the read memory pulse, as this must occur during the time that the address bus is stable. In any event, we should alternately push the restart button and look at each of the address lines to see that the desired starting address is being presented to the ROMs during the time of the read memory pulse. Fig. 5 shows a read memory bar (low is true) on the top trace and an address line on the lower trace showing a good zero. No read memory pulse? Probably a bad CPU chip. What you may find is that the leading edge of one of the address lines, either rising or falling, occurs during the read memory pulse. Since this pulse says that the addresses are stable, something is awry. Since there should be nothing on the address bus other than the microprocessor itself and the ROM, the problem is probably not excessive capacitive loading of the bus.

More probably, it's a faulty bus driver/receiver chip if one is used, or a short to Vcc or ground. A lack of noise on an address line is a good indicator of a short to ground. Usually, one address is found to be at fault, and this quickly isolates the offending chip or shorted line. Should all of the address lines be pulling to the required one or zero during the read memory pulse time, then we must look elsewhere for the problem.

Data Bus

The troubleshooting of the data bus can be somewhat more tedious than the previous problems, and so it is left to last. Part of the problem is due to the fact that it is a bidirectional bus and can be transmitting data either to or from the microprocessor. Since the bus is bidirectional, some means must be maintained to keep track of whose data is on the bus at any given time. In a simple system this is easy, because the microprocessor is controlling the bus, and the interfaced hardware has only specific times during which it can put data on the bus.

To digress a moment, although the reader may be familiar with TTL (transistor-transistor logic), to understand the concept of a bidirectional bus, tri-state logic must be brought in (not at the expense of open collector buses, but it is easier to see what is happening on them). Not that understanding them is difficult, for when it is enabled, a tri-state output looks like any other TTL signal. When the chip is not enabled, the output assumes a high impedance state. Referring to Fig. 6, it can be seen that the normal TTL output is a totem pole arrangement of two transistors, one of which is nor-

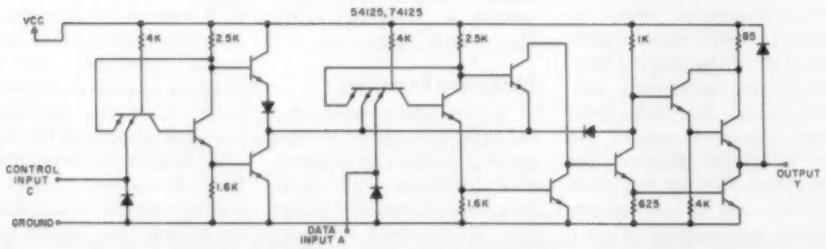

Fig. 6. Schematic diagram of a Signetics 74125 quad bus buffer gate with tri-state output. During the tri-state condition, both output transistors are in the high impedance state.

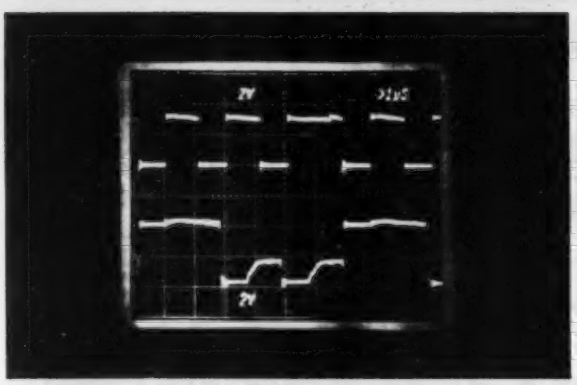

Fig. 7. The top trace again shows the read memory bar ($\overline{RM}$) pulse to allow proper interpretation of the data bus information on trace two. Note that during the first two $\overline{RM}$ pulses the data bus line shows a good one, but during the third $\overline{RM}$ pulse the line shows neither a good one nor a good zero, indicating that the microprocessor was addressing nonexistent memory or the memory at that location was malfunctioning and putting nothing on the bus.

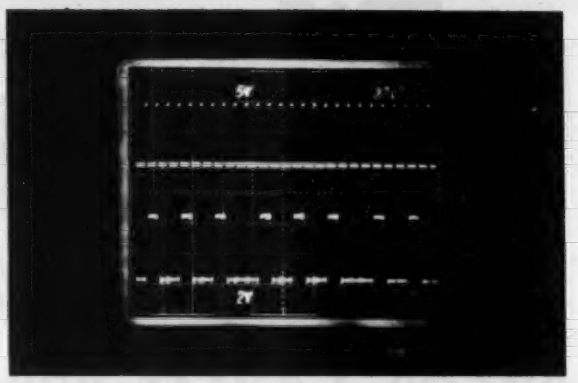

Fig. 8. The top trace is phase one of the clock and the bottom, the synch pulse of a normally operating system. Time between synch pulses will vary, depending on the instruction being executed.

mally on while the other is off. In fact, what accounts for the large noise spikes in TTL circuitry is that for nanosecond periods of time, both transistors may be on, causing a direct short to ground from Vcc. Looking at it binarily, there is only one other possible state for the two transistors, and that is with both of them off. In this case, looking back into the output of the tri-state device, we see a high impedance to both ground and Vcc and, hence, a very low loading of the data bus.

In the simple case of our jump-to-self instruction, the microprocessor releases control of the data bus during the read memory pulse (and slightly before and after). It is this pulse (read memory) that is logically combined with the decoded address on the address bus to provide a chip enable signal to the ROM so that its tri-state output is enabled and the next instruction put onto the data bus. So the first thing we must do is to look at the pin on the ROM for the chip enable to see if it is, in fact, being enabled. A lack of a chip enable signal says that the problem can now be localized to the chip-select decoding circuitry. If it is present, we continue by looking at the data bus, bit by bit, in synch with the read memory pulse. (At least one should be generated each time the microprocessor is reset.) While it is typically the case that all of the data lines are pulled high (through externally supplied pull-up resistors) so that they go to a known state while they are not being enabled, this is not required, and you may see a data bus without them that looks like Fig. 7. Note that the information on the bus is only valid during the read memory pulse time, so both signals must be displayed, or at least synched. Check, as with the address lines, to see that the data is fully a one or a zero during the time that the read memory pulse is there. Fig. 7 also shows the effect of nothing being on the bus during a read memory pulse. [During the third read memory bar (low is true) pulse, the data bus is neither high nor low.]

If All Else Fails

About the only thing left that can give you fits is an unpredictable interrupt being forced onto the microprocessor through a faulty interrupt controller, an interrupt line that is going low, or one that is not tied high through a resistor (allowing noise to pull it low). Check all interrupt lines for noise. If the chips are mounted in sockets, remove them, use solvent, and reinsert them to allow for a possible faulty interconnect. The same goes for the insertion of the board into its socket. This can be a great source of intermittent aggravation, when it dies every twenty minutes and then starts up with no problems. Another somewhat elusive problem is changing chip parameters with an increase in temperature, especially if the device is being run at close to its rated speed.

So, let's assume that life is not being cruel to you, and the first time that you put the jump-to-self instruction in, the synch pulses look like Fig. 8, and everything else appears to be operating normally. Now is the time to put your rudimentary monitor program ROM back into memory and see if the monitor functions (e.g., reads memory, changes registers, etc.). If not, recheck with a scope all of the address lines, data lines and interrupt lines. After a while, you can tell when a line looks correct, even without doing all of the synching, etc. You may want to still check them while you synch with the read memory pulse to check for a slowing of the response of the address and data buses due to capacitive loading increases when additional ROMs are added. If you don't have a small monitor program, put in the minimum amount of software and interface that you need and see if it will work. Slowly add interfaces and memory until the problem occurs. If you are lucky, you should be able to look at each of the address and data lines and see the one that is degraded by the malfunctioning board. If those show nothing, look on the most recently inserted interface/memory board to ascertain if signals are getting through to it. Perhaps it is being enabled all of the time, or conversely, never, due to faulty logic on the board. Hopefully, the insertion of boards one at a time will point out the defective board, and a look at all of the lines going to that board will give you a starting place for troubleshooting.

Read the Manual

Since you probably plugged the thing in before you really understood it, and it (miraculously) worked, or it worked after you only read half of the book, read the other half. Experience has shown that the microprocessor is probably not running because you forgot to read footnote number three at the bottom of page sixty-seven, which says that pin five of board six must be grounded for proper operation. ■

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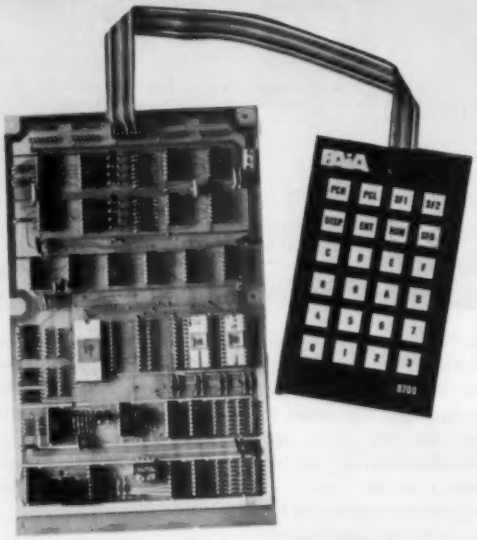

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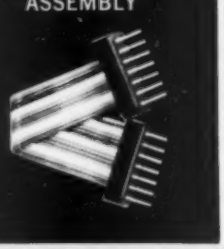

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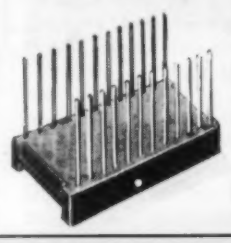

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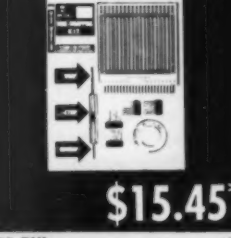

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Super DVM

- - uses the MC14433 and LCD

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I have, for a long time, wanted to replace my old reliable Simpson 260 due to its rapidly deteriorating condition. My first thought, thanks to some free samples from various companies, was to go the route of a voltage to frequency converter. Well, by the time I decided to start development on it, I had been transferred to Austin, Texas, where I was introduced to the new Motorola chip, the MC14433 analog to digital converter (DVM) chip. My first attempt was an LED version, with limited functions (volts only). The current demand on the batteries was not too bad – about 60 mA. With nicads, this could be taken quite easily. But, wanting to expand my horizons and to know what makes those funny liquid crystal displays work, I decided that the next voltmeter would contain only devices which wouldn't suck up all the juice out of the batteries. Before we get into the actual circuit construction, let's start from the top with design theory.

The Display

The operation of a field effect liquid crystal display depends on changing the optical properties of a liquid crystal by applying an electric field. The best short description of a liquid crystal is that it is an ordered fluid. Crystals of this type (liquid) which are used in displays belong to a class called *nematic;* fluids of this type consist of cigar-shaped organic molecules with the long axis of each molecule pointing in the same direction. There are three main types of chemicals which are used in displays. These are Schiff-bases, esters, and biphenyls. At the present time, the Schiff-bases are the best choice for displays, taking into consideration switching times, reasonable threshold voltages, lifetimes, good temperature ranges and expense.

The Motorola MLC 400* is constructed from two pieces of glass coated with transparent indium oxide conductors. These conductors are shaped to form the segments of a numeric display. The glass surfaces are also specially treated to align the liquid crystal molecules in a particular direction. Alignment is parallel to the plane of the glass, with the alignment direction of the top rotated 90° relative to the alignment of the bottom plate. This causes the liquid crystal molecules in the cell to assume a twisted orientation, when viewed from top to bottom. The plane of polarization of plane-polarized light will follow this twist and emerge from the cell rotated ninety degrees. Thus, if the cell is placed between crossed polarizers, the polarizers will transmit light. Where an electric field is applied, the liquid crystal will align parallel to the field, twist will be destroyed, and that portion of the cell will

*From Motorola Communications Engineering Bulletin #42, *Motorola Field Effect Liquid Crystal Displays – A light look.*

appear dark between crossed polarizers. Now I bet you didn't think all of that could fit inside a watch case, did you?

The MC14433

The MC14433 is a high performance, low power, 3½ digit A/D converter combining both linear CMOS and digital CMOS circuits on a single monolithic IC. The chip is designed to minimize use of external components. With two external resistors and two external capacitors, the system forms a dual slope A/D converter with automatic zero correction and automatic polarity. The MC14433 is ratio-metric, and, by itself, may be used over a full scale range from 199.9 millivolts to 1.999 volts. Systems using the MC14433 may operate over a wide range of power supply voltages for ease of use with batteries. In addition to DVM/DPM applications, the MC14433 finds use in digital thermometers, digital scales, remote A/D, A/D control systems, and MPU systems and has an input impedance of greater than 1000 megohms!

This A/D system performs a ratio-metric A/D conversion; that is, the unknown input voltage, Vx, is measured as a ratio of the reference voltage, Vref. Therefore, a full scale voltage of 1.999 V requires a reference voltage of 2.000 V, while a full scale voltage of 199.9 mV requires a reference voltage of 200 mV. Both the Vx and Vref are high impedance inputs.

OK, now that we have gone through the dry stuff, let's dig into the actual meat of the article.

The circuit in Fig. 3 performs parameter-to-voltage conversions, scaling and function switching. The ac/dc DPST switch changes the input path and the signal is then fed into the MC14433. A 10 megohm voltage divider consisting of three precision resistors provides 2, 20, and 200 volt ranges. Three precision shunt resistors are connected directly from the input to ground, providing 1 A, 200 mA, and 20 mA scales.

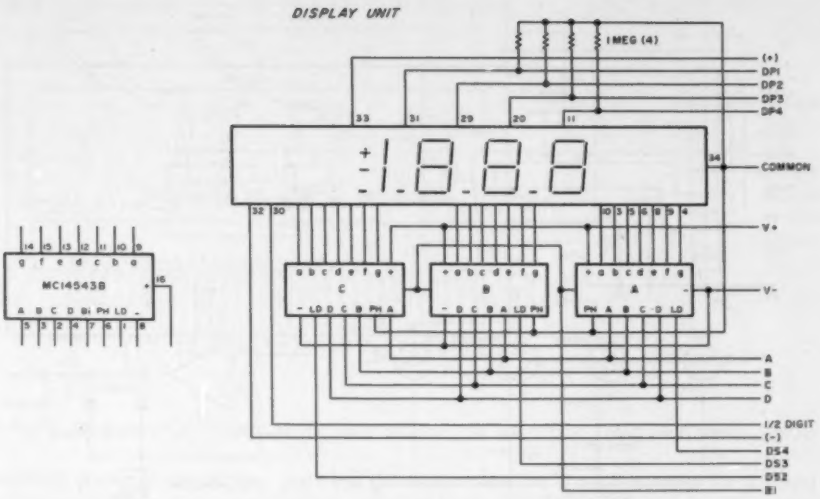


Fig. 1.

The resistance scales are established with calibrated current sources using the MC78L05 and MC79L05 voltage regulators. A stable 5 volts above the minus supply is produced by the 78L05 positive regulator. The current sources are simple base emitter biased transistors. A 2N930 with a guaranteed beta at 1 microamp is used for the 2 megohm scale, and an MPS6513 is used as a .1 mA source for the 20k Ohm scale. Each is adjusted by a single ten-turn pot. The 200 Ohm scale current source uses a 79L05 negative regulator. Its input is connected to the negative supply and a scaling resistor is placed between the common and output pins. When not in use, this circuit draws only a few microamps of bias current, even though it sinks 10 mA when measuring a connected load. All current sources are biased from the minus supply to increase battery life; thus, all resistance scales produce a negative sign on the display.

When I first was breadboarding the circuit, I took the minus supply for the input circuitry from the common -6.2 V bus. The only problem with this is that the 78 and 79L05 regulators require about 2 to 3 volts over the output voltage to work properly. Thus, the regulators will require at least 7 to 8 volts on the input to give 5 volts on the input to drive the LCD. No wonder I was getting funny readings! For this reason, I recommend the use of 9 volt batteries. Note that absolute maximum voltages on the MC14433 are + and - 8 V, so be sure to drop that portion of it somehow.

The real substance of the project is shown in Figs. 1 and 2. Three MC14543N LCD latch/decoder drivers are used to demultiplex, decode the three digits and drive the LCD. The half digit and polarity are demultiplexed with the MC14013B dual D flip-flop. Since the LCD requires an ac signal across it, the low frequency square wave drive for the LCD is derived from the MC14024 binary counter, which divides

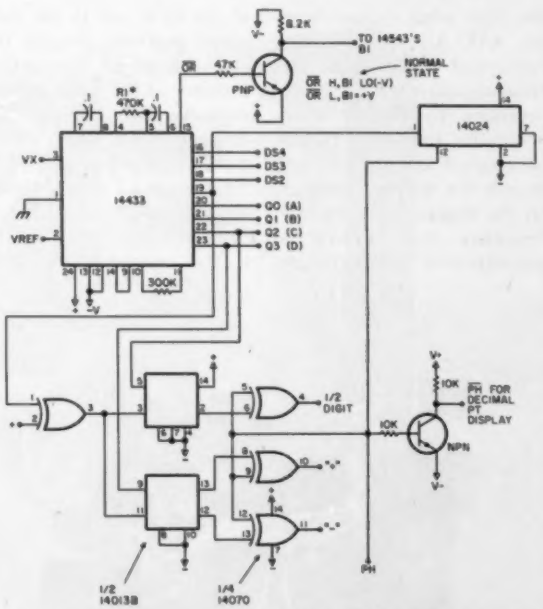


Fig. 2. For V full scale = 199.9 mV, set Vref = 200 mV and R1 to 27k Ω. For V full scale = 1.999 V, set Vref = 2 V and R1 to 470k Ω.

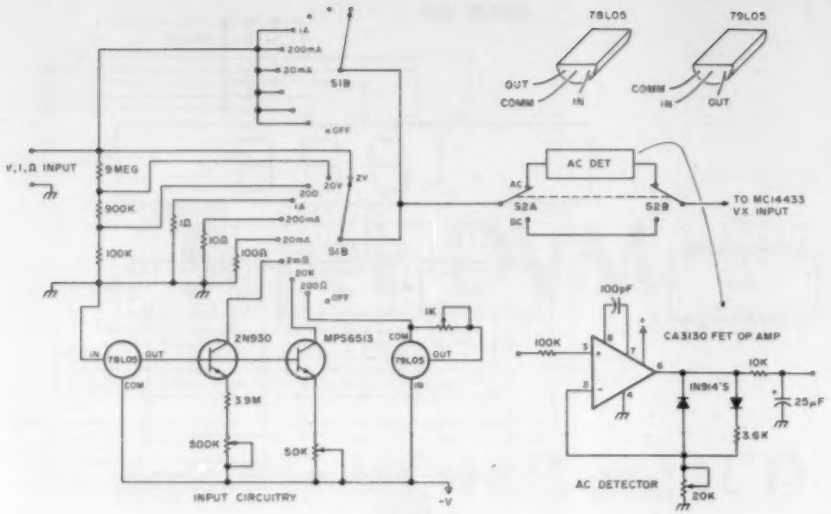


Fig. 3.

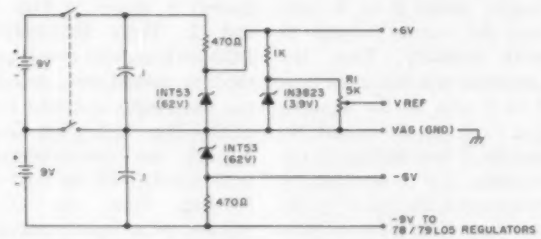


Fig. 4. Power distribution. Set R1 for an output voltage of 2 V. It must be accurate and with load connected. Any zener diode of equivalent value may be used.

the digit select output from the A/D. Although this is a convenient way to obtain the required square wave, it is not necessary to take it from here. The frequency should be about 4 kHz, as this will provide for the best contrast on the display unit. This low frequency square wave is connected to the backplane of the LCD and to the individual segments through the combination of the output circuitry of the 543B and the exclusive OR gates at the outputs of the 013B. All of the decimal points are tied to PH through a 1 megohm resistor, and, to display a particular DP, it is switched to $\overline{PH}$.

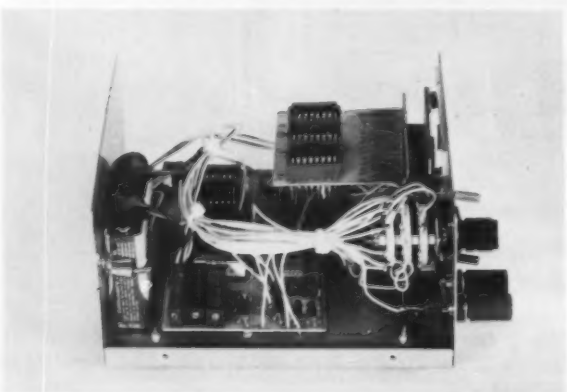
The overrange pin (15) goes low when Vx exceeds Vref. It is normally high. The 543Bs require a ground on pins 7 (blanking) to display. In our case, the ground is actually the most negative supply (to get the maximum amount of voltage swing on the output). This normally high $\overline{OR}$ pin on the 433 is tied to a PNP transistor, which is tied between -V and +V. In its normal state, the transistor is not conducting, thus allowing the -V to be on the collector. When the input goes low, indicating an overrange condition, the transistor conducts and places a high (+) on the blanking input of the 543s, thus blanking them. Note that the first digit has no provision for blanking.

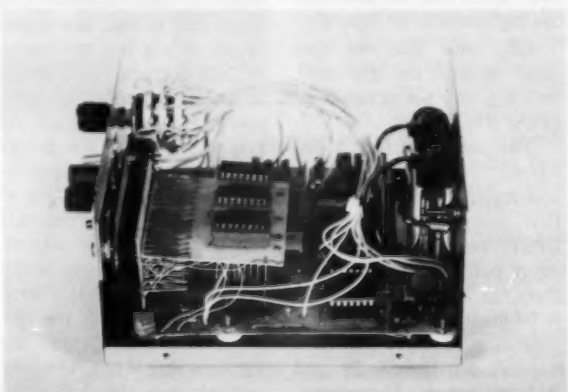
In my version, I wire-wrapped the LCD socket and the 543Bs. I did this for a couple of reasons. The first reason is because the pins of the socket of the LCD are very close together, and I didn't want to hassle with the artwork. The second reason is that my wife gave me a hobbywrap tool for Christmas, and I wanted to try it out. It would, of course, have been permissible to etch the whole board, but I elected to go with the wire-wrap method. I later found out that Teledyne Kinetics, the maker of the LCD socket, also makes a socket that would allow construction on a single board.

Calibration

The first thing to do in the way of calibration is to set the reference voltage. Note on the schematic that it can be set up for 2 volts or 200 mV full scale. I recommend that it be set for 2 volts due to possible noise problems, but, even with the 2 volt scale, it can be read to .001 volt. Be sure to be accurate with this reference voltage, as the accuracy of the entire instrument depends upon it. A short word about the quality of components used in the frequency determining resistors and capacitors, especially in the capacitors. These .1 uF caps should be of the high quality polyester or mylar. Using cheap caps here can lead to inaccurate readings.

If you used precision resistors for the voltage divider network, the next step is to calibrate the Ohms scales





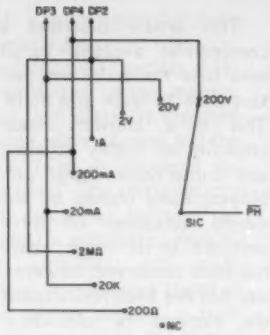


Fig. 5. Decimal point switching. To energize DP, tie line to PH.

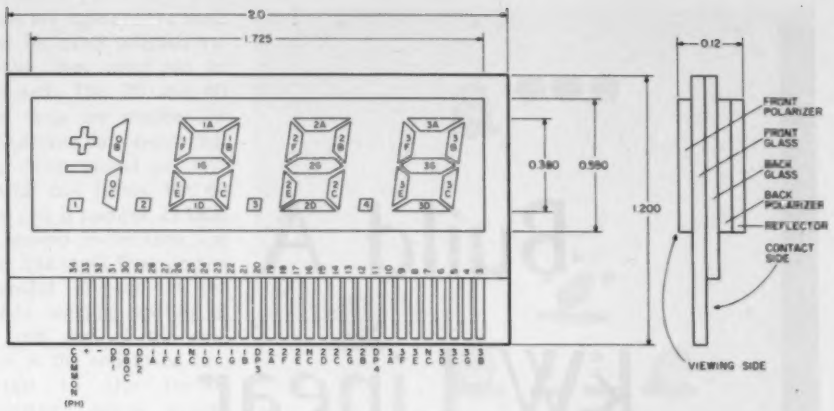


Fig. 6. Diagram of MLC400 liquid crystal display. Use connector Teledyne Kinetics S202U.

against known resistance values. Just tweak the control until the correct value is displayed. If you used pots in place of the precision resistors (in the interest of saving money), you must set these up. The way to do this is to get a calibrated voltage source. Set the voltmeter to the 200 volt range, and adjust the 100k pot for a correct reading on the meter with about 90 to 120 volts applied to the input. Watch out, as the 433 doesn't really like all that voltage, especially if it is applied directly to the 2 V scale. It might blank out forever! After you have calibrated the 200 volt scale, don't touch that pot again. Apply about 16 volts to the input, and adjust the 900k pot for a correct reading. Next, do the same thing for the 2 volt scale, using the appropriate voltages. After this, you will probably have to touch each of the pots up, as each will interact with the other. With a little time, you can save yourself a little money, and probably have a more accurate meter than if you were to buy precision resistors!

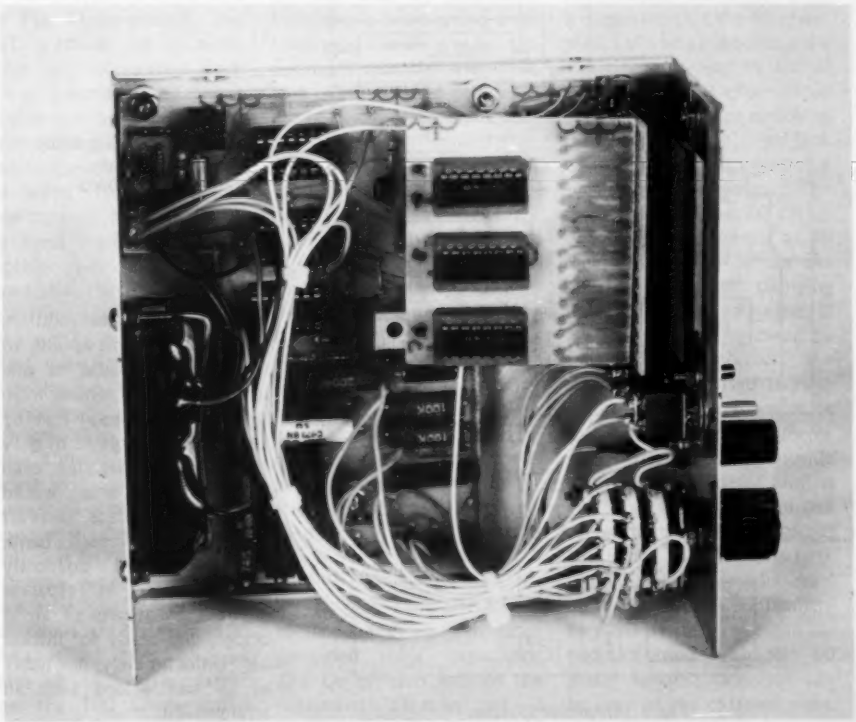
There are a few things which you should be on guard for, and those are in the area of the ac detector circuit. Since this is essentially an amplifier/detector circuit, anything that is placed on the input will show up as a dc potential on the output. This little lesson was painfully shown to me, as the ac detector circuit took more time to refine than did the rest of the DVOM. On the switch assembly, I ran the PH and $\overline{PH}$ lines with unshielded wire. This was a real no-no, as the input is a very high impedance, and therefore doesn't take very much to drive it. So, a little shielding and careful placement took care of it.

To calibrate the ac scale, the easiest way is to set up the voltmeter to the 200 volt scale and the measure the line voltage of your house. If it does not read correctly, turn the pot until it does.

Another little hint — be sure not to hook up the analog ground to chassis ground as if you are measuring current in a high voltage circuit. This will place a high potential on the bare metal chassis. In my DVOM, the chassis is floating and not connected to anything. At the present time, I do not know where the display unit can be purchased, but a rough price estimate for it would be about $14.00. The chip is available from Tri-Tek for $18.95.

PC boards for a basic 2 V DVM using LEDs can be purchased from Dactron, Inc. 12609 Blackfoot Trail, Round Rock TX 78664.

In addition to this basic 3½ digit 2 volt LED DVM, this company is coming out with the following items: plug-in board with full function, autoranging capabilities, LCD version, and a digital thermometer. ■



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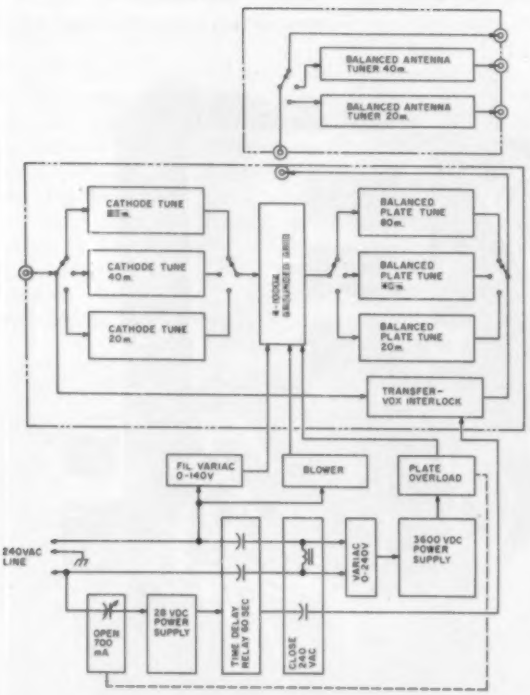


Fig. 1. Amplifier system.

The ultimate station, from the viewpoint of most of us, would be one located on a hill remote from noise sources, having separate, large, highly elevated antennas for each band. The ham shack would contain a separate kilowatt transmitter for each band, pretuned and correctly matched to its separate antenna by means of an rf bridge, and ready for instant use. Unfortunately, not many of us can afford such an arrangement.

This article describes a compromise available to all who have the desire and perseverance to learn and build. This is a kilowatt linear amplifier of highly efficient and conservative design employing band change by the simple actuation of three switches. In its design, space has been conserved; however, size has not been restricted at the expense of efficiency, reliability, or signal quality.

Quite common in the 1930's and 40's was the push-pull output circuit using two tubes, a balanced tank circuit, and link coupling, well known for its high efficiency and for cancellation of even order harmonics. The grounded grid circuit was known but not commonly used. In this amplifier, the balanced tank circuit is adapted to use with a single 4-1000A tetrode, used in a grounded grid, grounded screen circuit with link coupling. Harmonic distortion products are minimized. Efficiently tuned and correctly matched input circuits are used to improve signal quality and reduce drive requirements. The 4-1000A is run at an efficient plate voltage and loafs at a kilowatt dc input.

System

Fig. 1 is a block diagram showing the functional arrangement of units for power supply, signal amplification, and antenna matching. The amplifier input and output circuits are continuously tunable across the 80, 40, and 20 meter bands. A tuned link for each band feeds the output to separate antenna tuners for 40 and 20 meters, which in turn feed 95 Ohm balanced coaxial lines. The 50 Ohm unbalanced input to the antenna tuning unit is fed straight through on 80 meters to a 50 Ohm unbalanced line.

Sixty seconds is allowed for filament heating before high voltage is applied. For tube protection, the high voltage is removed from the tube when plate current ex-

ceeds a value which has been preselected by the operator. Simultaneously, exciter drive is transferred to the antenna tuner (still correctly matched to the exciter output) and the VOX relay is rendered inoperative. The sixty-second time delay then recycles, the antenna is transferred back to the amplifier, and plate voltage is reapplied together with exciter drive. If a fault continues to exist, the system will continue to recycle until operator intervention occurs.

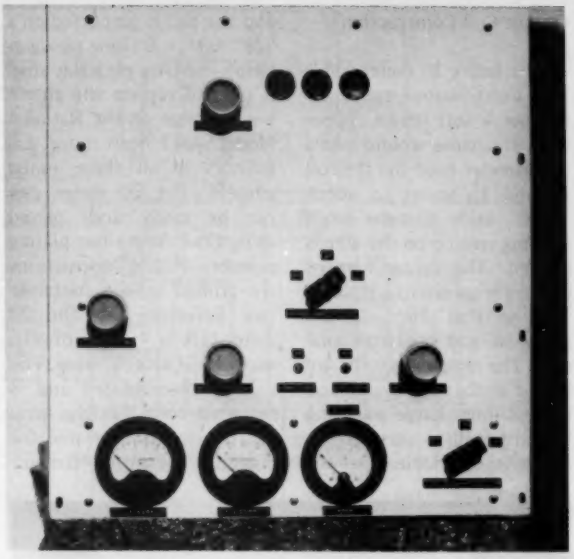
A large capacity heavy-duty blower is contained in an enclosed box at the bottom of the amplifier cabinet. An air filter is provided. Air from the blower is discharged into a plenum chamber and thence through a flexible hose to the pressurized amplifier chassis. Separate meters provide full monitoring of the tube voltages and currents. The system is contained in a 23" wide by 24" deep by 62" inch high metal rack cabinet mounted on casters. Total weight is 450 lbs. Cost, including 2 4-1000As, is $350.

Input Tuned Circuits

The input circuits are shown in the Fig. 2 schematic. Table 2 contains the values of all components and the number of turns for inductances. The input circuits are series tuned by means of small broadcast type variable capacitors. Variable capacitors provide a straightforward method of correctly adjusting the networks to a correct impedance match between the line and the cathode to grid load of the tube at the selected resonant frequency. Considerable interaction exists between components of the tube input circuit, and fixed capacitors are not recommended as a means of establishing correct tuning. The input capacity of the 4-1000A is a nominal 27 pF and series tuning works well in this application. Qs of the tuned circuits vary from 1.5 to 3, and once the input circuits are tuned to the band center (or other selected frequency), they need not be readjusted. The 20 and 40 meter coils are number 14 DCC (double cotton-covered) wire, close wound on 1½" diameter coil forms. The 80 meter coil is number 22 DCC wire wound on the same size form. The input line winding is wound on top of the cathode winding starting at the cold end of the coil, which is the end to be connected to the tuning capacitor. Allow enough dangling wire to make connections to the tuning capacitors and to the selector switch S1.

The only practical means of evolving the input tuned circuits was found to be one of cut and try. Originally, the input circuit values were calculated for Qs of two, and a complete subassembly consisting of the three coils, six tuning capacitors, and switch S1 was built up on a sheet of 1/8" aluminum. The subassembly was then tested using the following procedure:

A load of 100 Ohms in parallel with a 30 pF capacitor was connected from S1B (see Fig. 1) to ground. The ANT terminal of a noise bridge was connected from S1A to ground and a receiver S-meter was used to measure signal strength versus resonant frequency for a 50 Ohm line input. The inductances were tailored to resonate at the band center. After the amplifier was built, it was found that the input circuits would not resonate correctly and that the input impedance values were far from the 50 Ohms desired. The input subassembly was removed and, with the tube in its socket and a 100 Ohm resistor connected from one side of the filament to ground, the input impedance of the complete input circuit was measured with the noise bridge. The impedance was found to be 135 Ohms at 3.8 MHz, 120 Ohms at 7.2 MHz, and 85 Ohms at 14.2 MHz, rather than the 100 Ohms I had expected it to be from the manufacturer's data for the tube. The published data is the dynamic load impedance only of the tube.



Amplifier panel showing controls. 80 meter tune at top, 80 meter link tune extreme left, 20 meter tune and 40 meter tune centered left and right of plate bandswitch with screwdriver adjust link tune between plate knobs. Cathode band select at lower right. Meters from left to right are plate current, grid current, and filament voltage.

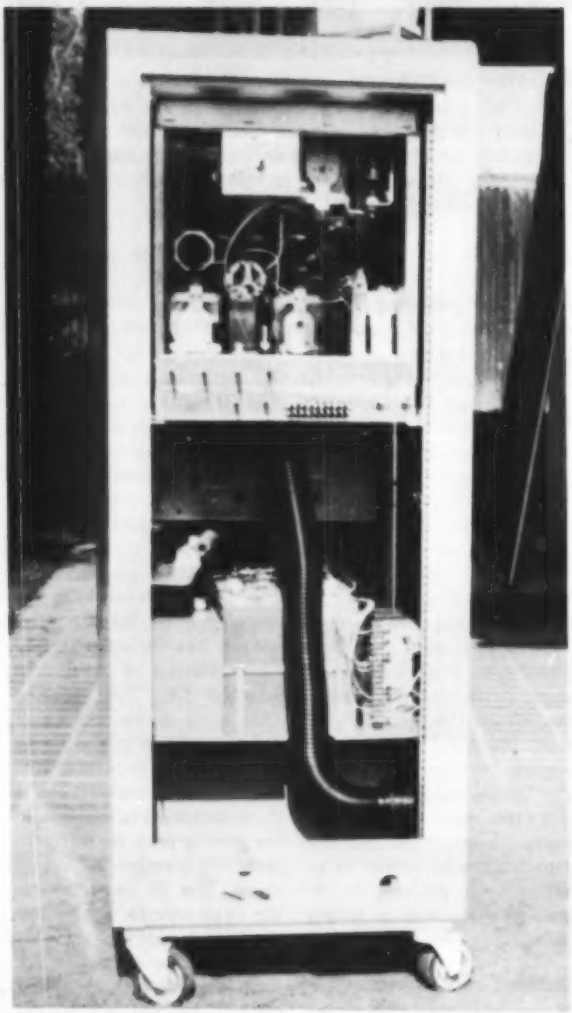
At this point, I resorted to the cut and try approach. Inductances were varied until resonance was obtained at the desired frequencies with close to a 50 Ohm load presented to the exciter line input connection. It was learned that one cannot obtain a given value of Q at a chosen resonant frequency and match a tube input load to a 50 Ohm input line impedance when using fixed coupling. This is the reason that the Qs vary from about 1.5 to 3, as previously mentioned. However, the Qs are quite acceptable, and the amplifier is very easily driven. The variable capacitors were found to be invaluable in evolving the input networks and in tuning them.

Output Tuned Circuits

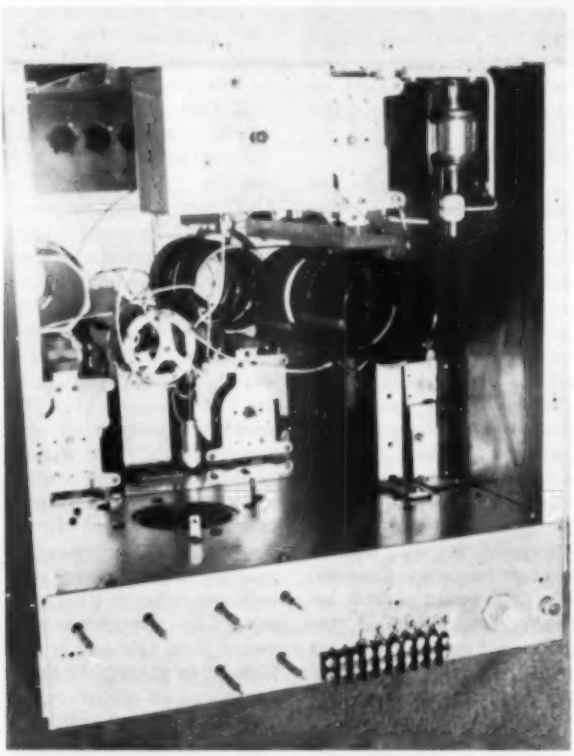
The plate tank circuits are balanced and use split-stator grounded rotor capacitors. The Qs of each half of the resonant circuits are a nominal 6. The output links are series-tuned circuits having Qs of about 3. The links of this amplifier were made variable for the 20 and 40 meter coils and fixed for the 40 meter coil; however, it is suggested that the 40 meter plate coils be air wound and a swinging link used in lieu of the fixed link. I experienced the same impedance matching problem with the fixed link as previously discussed for the input networks. The impedance of the 40 meter output link ended up at 40 Ohms instead of 50 for the selected Qs. The swinging links are a pleasure to use. If the impedance presented to the line is incorrect, the coupling is increased to raise it, or decreased to lower it. In the photographs, the 80 meter tank coil is suspended upside down. The 20 meter tank is the large wire air wound coil on the right side looking from the back. The 40 meter tank is on the left side. Mounting method for the supplementary 50 pF fixed vacuum capacitors used with the 80 meter variable capacitor can be seen at the extreme right.

Output Coil Construction

The entire 20 meter coil is 12 continuous turns of number 4 soft drawn copper wire. It is close wound over a 3" diameter tube and the coil allowed to spring to about 3-1/8" inside diameter when winding tension on the wire is relaxed. The center turn of the coil is spread to a pitch of 1¼" so that the link will swing in and out from one side. The remaining turns are spread so that the overall coil is 5½" long. Large soldering lugs are used to connect the coil to the variable capacitor and the coil is supported on a 3/8" x 1" x 9" long plexiglas strip. This size plexiglas strip is used to replace the aluminum top bar on the National Model AMT split-stator capacitors in all three tuned circuits. The 20 meter coil can be easily silver plated using Cool Amp silver plating powder. Plating instructions are printed on the container (see Reference 1). The 20 meter link is 4 turns of #16 wire, 2½" OD x ½" wide. The link is silver plated and is mounted on a plexiglas strip off the capacitor frame for pivoting. The entire 40 meter coil is 19 turns of #10 enameled wire 3" OD (outside diameter) x 3¼" long wound on a ceramic form. The 5 turn link is wound over plexiglas strips cemented to the wire. The link is 3-3/4" OD x 7/8" long. The 80 meter coil is wound in two sections. Each section is 17 turns of #10 wire, 3-7/16" OD x 3" long. Close wind the coil on a 3" OD tube and allow it to spring out when winding tension is released, then insert three 1/8" x 1/4" x 5" strips between the 3" tube and the inside of the coil spaced equally around the diameter. Wind .06" diameter insulated flexible wire around the form over the strips, as spacers between the coil turns. Stretch the spacing wire tight enough that it forms a straight line between the spacing strips and the result will be a clearance space between coil turns and the spacing wire at three locations around the circumference of the coil. Plexiglas strips 1/8" x 1/4" x 3-1/8" long can now be cemented to the outside of the coil wires using DuPont Duco Cement. Let dry overnight, then slide the spacer strips out and remove the coil from the tube. The spacer wire will fall out on the inside of the coil and more Duco cement can be applied across the plexiglas strips from inside the coil to complete the job. The two coils are cemented to a 3/8" x 2" x 9" long plexiglas strip so that the center line of the coil is offset 1-1/4" from the capacitor shaft center line when the coil is mounted on top of the capacitor. This construction allows the capacitor to be placed close to the chassis edge yet spaces the coil away from the metal enclosure. A two inch space is allowed between coils at the



Rear view showing blower box at bottom with flexible hose to amplifier chassis. Amplifier slides in/out on supporting angles. Rear cabinet door and rear amplifier panel are removed for the photo.



40 meter tank at left, 20 meter tank at right bottom, 80 meter assembly right top. One of the two 80 meter fixed capacitors is visible at right top. The box at top center contains the plate rf filter assembly. The three small angles around the tube socket center the chimney.

center for the swinging link. The link is 8 turns of #10 wire x 1-1/2" long of the same diameter and construction as the main coils. A piece of 3/8" x 1" x 3" long plexiglas is filed to the coil radius and cemented to the coil as a swinging arm. The arm is supported from the chassis on a 1/8" x 1" aluminum bracket as a pivot support.

Antenna Tuners

The antenna tuners use commercial coils: Johnson 500 HCS40 on 40 meters and Johnson 500 HCS20 on 20 meters. Although these are 500 Watt coils, they are more than adequate for use in a series-tuned 1 kW circuit. The antenna tuner links are fixed. They are cemented to plexiglas strips and supported from the main coils at the center of the main coils. These links are #16 wire of 2-1/2" OD, 4 turns (3/8" long) on 20 meters, and 8 turns (3/4" long) on 40 meters. If you wish to wind your own, simply duplicate the 40 and 20 meter plate tank coils, except #10 wire may be used for the 20 meter coil instead of #4 wire, if desired. An advantage of the #4 wire is that the coils are self-supporting and very simple to make as compared to the #10 wire coils reinforced by plastic strips. The variable capacitors used for tuning the plate and antenna tuner links should have a minimum spacing between plates of 20 thousandths. Screwdriver adjustable types are suitable since they need only be tuned occasionally. The split-stator capacitors used in the antenna tuner output circuits can be of 20 thousandths spacing if series tuning is used, as in this tuner. If the flexibility of parallel output tuning to match high impedances is desired, use a capacitor having plate spacing of at least 1/8 inch.

Metering

Filament voltage, plate voltage, grid current, and plate current are indicated by means of separate meters. The advantage of separate meters is that overall performance of the amplifier is apparent at a glance and, particularly, grid and plate current can be monitored simultaneously.

The grid must be held very close to ground potential to avoid the generation of high frequency parasitic oscillations. The most commonly used method of accomplishing this and yet of obtaining an accurate measurement of drip current is to raise the grid slightly above ground potential by means of a low value resistor and to measure the voltage drop across the resistor (as grid current flows through it) by means of a voltmeter calibrated to read grid current. Mock up the grid metering circuit consisting of R5, the meter, a variable dc voltage source from grid to ground, a variable resistance in place of R6, and a second milliammeter in series with the grid current meter. Vary the supply voltage and the variable resistance to arrive at tracking of the two meters. Measure the value of R6 required and substitute a fixed value.

The filament voltage meter leads are connected directly to the tube socket for accuracy of measurement. Shielded wire runs from the socket to the meter. Use a one percent accuracy meter for this application.

The values of resistance required for plate voltage and current metering can be calculated simply and accurately. For example, assume that plate voltage is to be measured using a 0-15 milliammeter with the legend on the meter face changed to read 0-4500 V dc. Then 15 mA must flow through the

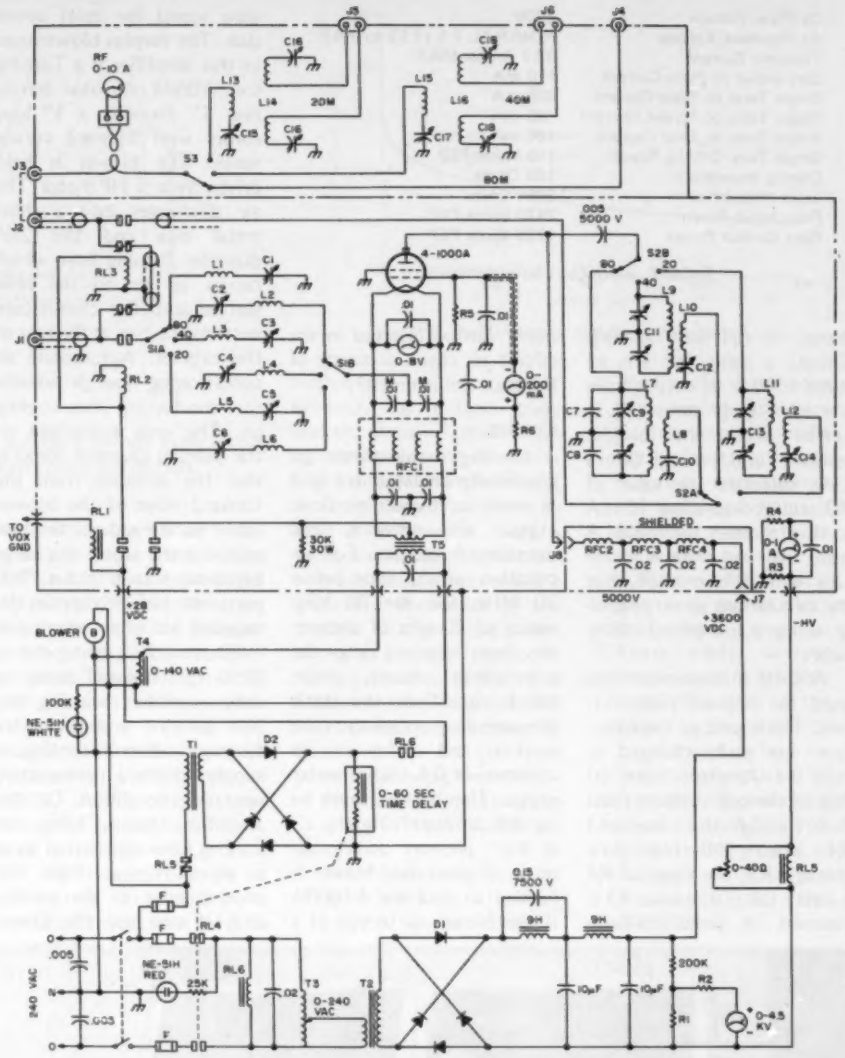


Fig. 2. Amplifier schematic.

Dc Plate Voltage	3600
Ac Filament Voltage	NOMINAL 7.5 (7.13 to 7.87)
Filament Current	22.7 Amps. MAX.
Zero-signal dc Plate Current	110 mA
Single Tone dc Plate Current	685 mA
Single Tone dc Screen Current	90 mA
Single Tone dc Grid Current	160 mA
Single Tone Driving Power	115 Watts PEP
Driving Impedance	105 Ohms
Load Impedance	3050 Ohms
Plate Input Power	2470 Watts PEP
Plate Output Power	1725 Watts PEP

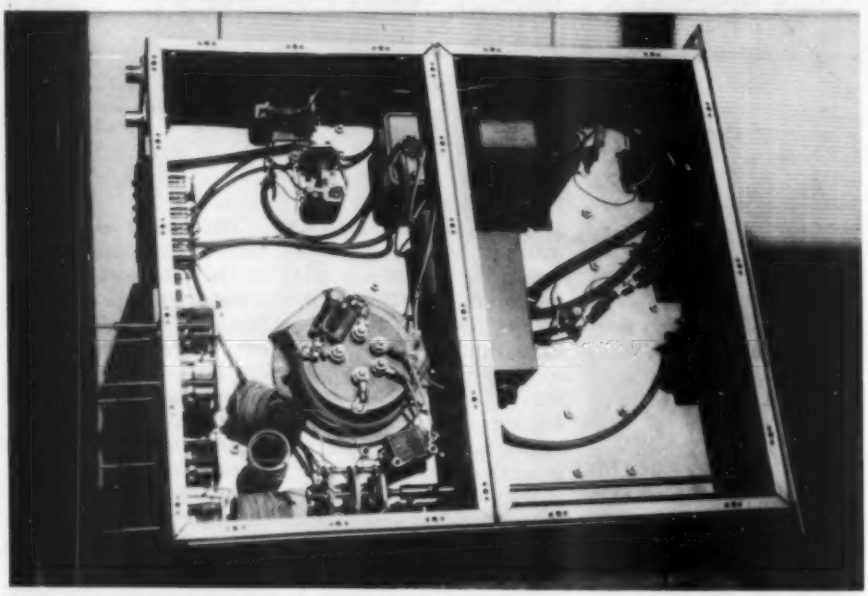
Table 1. 4-1000A characteristics.

meter for full scale reading. Choose a value for R1, assume 4500 V dc output from the HV supply across R1 in series with the bleeder resistor, and, using Ohm's Law, calculate the value of R2 required to allow 15 mA to flow through the meter. A little trial and error is necessary with this method, but the calculations go very rapidly using a low-priced calculator.

A 0-10 milliammeter was used to measure plate current. The legend on the meter face was easily changed to read 0-1 Ampere. Since 10 mA of the one Ampere must flow through the meter and R4 when 990 mA flow through R3, the value of R4 is easily calculated once R3 is assumed. A series milliammeter can be inserted in the circuit to check accuracy of the plate milliammeter.

Cooling

Cooling requirements are graphically depicted in Fig. 3 in terms of blower air flow, static air pressure, and operating frequency. For application of the tube below 30 MHz, use the 30 MHz values of 20 cfm of ambient air flow required into the pressurized chassis, under which conditions the static pressure drop across the tube socket and tube in its chimney is 0.6 inches water gauge. The blower must be capable of supplying the air at 0.6" pressure as a minimum. A good-sized blower is needed to cool the 4-1000A if the blower is to run at a slow speed for quiet operation. The surplus blower used in this amplifier is a Torrington AD508 Airrotor having two 5" diameter x 3" long rotors with forward curved vanes. The blower is belt-driven by a ¼ HP motor. The air discharges into a sheet metal box and the 2½" diameter flexible hose which carries air up to the pressurized amplifier chassis connects to the box at the rear of the cabinet. Automobile air conditioning hose is suitable for conducting the cooling air. The only constraint on the plenum chamber (box) is that the distance from the forward edge of the blower wheel to the side of the box opposite the wheel discharge be about 5 to 6 inches. This particular blower supplies the required air when running at 1400 rpm. It is being run at 2150 rpm because doing so only required reversing the belt pulleys, and the extra factor of safety in cooling air supply yields a conservative operating condition. On the amplifier chassis, bring the cooling hose connection in at a point remote from the cooling inlet to the socket, and, if you use the Eimac SK500 aluminum socket as I did, cut off the entire air inlet tangent to the machined circular surface to increase the efficiency of air flow. In addition, drill ten ½" diameter holes through the socket side wall to admit air.



Bottom of chassis showing switching relays at top left, feedthrough filters and input tuning capacitors at left. The right half of the chassis contains the meters, filament transformer, and filament choke. Note the advantage of the two chassis arrangement for shielding.

Power Supply

The power supply section contains the components indicated on the schematic. It is of conservative design using parallel resonant choke input followed by one section of brute force filtering. The first section is tuned to the main ripple frequency (120 Hz) and presents a sufficiently high impedance at this frequency such that a low bleeder current of 20 mA provides good no load to full load (500 mA) regulation. The low bleeder current conserves power and avoids a problem of bleeder heat in the equipment cabinet. The HV rectifiers are silicon stacks (see Table 2) and were obtained from R.E. Goodheart Co. (see Reference 2). If you build up your own, a peak inverse voltage rating of 5650 volts is necessary at 140 mA average current using bridge rectification. The rectifiers are mounted on a sheet of aluminum which acts as a heat sink. The 28 V dc relay supply, protective relays, and terminal board are submounted on a 5" x 8" x 1½" chassis from the ¼" x 20" x 20" aluminum plate which supports the overall supply. The plate is mounted in the rack at four corners using steel angles. The power supply panel is 19" x 12" high. It contains the on/off switch, fuses, panel lights, HV voltmeter, and the two variacs. More filter capacitance has been used than is absolutely necessary. A capacity of 4 uF from each choke section to ground is about minimum for a 3600 volt supply used on SSB. Fig. 4 shows the power supply regulation.

Mechanical Construction

The amplifier box is 17" wide x 20" deep by 20" high.

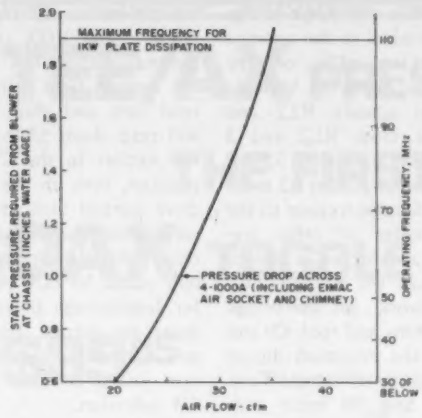


Fig. 3. Cooling requirements for 4-1000A tetrode using Eimac air socket and chimney at 1000 Watts plate dissipation.

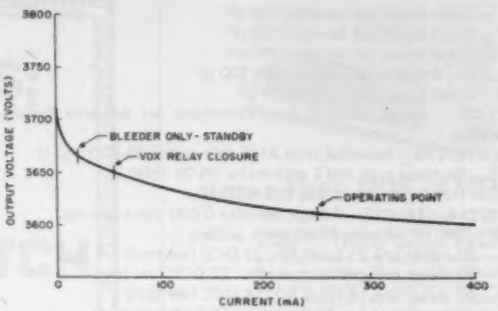


Fig. 4. HV power supply regulation.

It is made up of aluminum top and bottom chassis held together by four aluminum panels – front, back, and two side – plus one 17" x 20" bottom plate. The bottom chassis is made up of two 10" x 17" x 4" deep chassis fastened together by means of number 8 machine screws. The top chassis is made up of two 10" x 17" x 2" deep chassis fastened together. I could not obtain 17" x 20" chassis; hence, this construction. The top chassis is turned upside down, presenting what would be the normal chassis top surface to the inside of the box. Four ¾" x ¾" x 14" aluminum angles are mounted vertically between the top and bottom chassis to support the front and back panels and to form an rf tight enclosure. The side and front panels are fastened using through machine screws with nuts and lock washers. The back panel and bottom plate are held in place by means of number 8 nut plates.

The meters are mounted in the front of the lower chassis, which simplifies shielding and wiring. Since the meter holes extend through both the chassis and front panel, it is advisable to fasten the front panel to the chassis and then cut the meter holes straight through using a hole cutter of the adjustable arm type. The chimney for the tube is held in position by three 1/2" wide pieces cut from 3/4" x 3/4" x 1/8" aluminum angle. Allow 1/32" clearance between the angle and the glass chimney to allow for expansion. The input networks and selector switch are submounted on a sheet of 1/8" aluminum. The filter network for the HV, which consists of RFC2, RFC3, RFC4, and three .02 microfarad capacitors, is contained in a 5" x 5" x 4" box. J7 and J8 are insulated binding posts mounted in the box prior to wiring. Ten 1" diameter holes are drilled in the back panel to discharge air from the tube compartment. Aluminum screen wire can be used for shielding over the holes, or one inch diameter screened inserts can be purchased. The inserts contain tabs which are bent over to hold the insert in place in the hole. All shaft extensions are 1/4" diameter brass. Panel bushings are used for all front panel control shafts. All controls and meters were labeled using a Dymo tape marker obtainable in most drug stores. The entire rack and all front panels are painted with low-gloss off-white enamel. The aluminum panels were given one coat of etching undercoat prior to enameling. This is necessary so that the paint will adhere to the aluminum. Air leakage from the pressurized chassis must be minimized by use of a gasket between the bottom plate and the chassis. I used a sheet of plastic covering the entire bottom plate and cemented it to the plate in a few places to hold it in position. Using a sheet the full size of the plate is much easier than cutting a gasket to the width of the chassis flanges and then trying to position it properly for alignment with the holes in the chassis. Three one-inch holes containing shielding inserts are cut in the front panel for viewing the tube.

Practices of importance in rf amplifier construction are as follows:

1. Ground components directly to the chassis by the shortest route. Do not use a single point ground.
2. Use coaxial connectors and feedthrough capacitors or filters to bring conductors into the enclosures. Sprague 0.01 uF high pass capacitors are good as are a number of surplus line filters.
3. Use shielded wire for filament, power, and metering leads inside the amplifier chassis.
4. Use 0.01 or larger filament bypass capacitors. Use mica capacitors for the two marked M on the schematic.
5. Keep the lead from the plate cap to the switch and from the switch to the plate tuning capacitors as short as possible to minimize parasitics. The leads from the plate tuning capacitors to their respective coils can be longer, although if the construction practice used here is followed, they will be quite short.
6. Place coils at least one coil radius away from metal panels to keep eddy current losses at an acceptable level. The end of the plate coils opposite from the plate lead are intentionally placed ¾" from the adjacent metal panel to provide a 8 pF capacity to ground to balance the output capacity of the 4-1000A.

Tuning

Tuning of the amplifier input and output networks and adjustment of the antenna tuner is performed at this QTH using an antenna noise bridge. The following procedure is used. Remove the amplifier from the cabinet and remove the bottom plate. Place the 4-1000A in its socket and connect the lead to the plate cap. Connect a 3000 Ohm non-inductive resistor from the plate connection at S2B to ground. Connect a 100 Ohm non-inductive resistor from one side of the filament at the socket to ground. Connect the noise bridge antenna jack to S1A at the exciter input line connection points using leads as short as possible. Place S1 in the 80 meter band select position. Set the receiver (which is connected to

C1 – Small broadcast variable 300 pF
C2 – Small broadcast variable 150 pF
C3 – Small broadcast variable 200 pF
C4, C5 – Small broadcast variable 100 pF
C6 – Small broadcast variable 50 pF
C7, C8 – 50 pF vacuum from Command Set Antenna Tuning Unit (surplus)
C9, C11, C16 – National type AMT split-stator 50-50 7500 V
C13 – National type AMT split-stator 25-25 7500 V
C18 – B&W split-stator 100-100 4500 V
C12, C14, C15, C17 – 150 pF variable 0.020 plate spacing
C10 – 350 pF variable 0.020 plate spacing
L1 – 80 meter line 21 turns No. 22 DCC (see text)
L2 – 80 meter cathode 40 turns No. 22 DCC (see text)
L3 – 40 meter line 14 turns No. 14 DCC (see text)
L4 – 40 meter cathode 25 turns No. 14 DCC (see text)
L5 – 20 meter line 5 turns No. 14 DCC (see text)
L6 – 20 meter cathode 9 turns No. 14 DCC (see text)
L7, L8, L9, L10, L11, L12, L13, L14, L15, L16 – see text
J1, J2, J3, J4 – UHF receptacle JAN type SO239
J5, J6 – UHF receptacle (twin) JAN type UG-102/U
J7, J8 – HV insulated binding post from Commend Set Antenna Tuning Unit (surplus)
RL1 – surplus 28 V dc, two sets N.O. contacts required
RL2, RL3 – Ceramic insulated relays 28 V dc from Command Set Antenna Tuning Unit (surplus)
RL4 – Leach 0-60 second time delay relay 24 V dc (surplus)
RL5 – Basco SRIC2A2, 11000 Ohm coil dc relay
RL6 – 240 V ac relay, 2 sets N.O., 10 Amp contacts
T1 – 120 V primary, 32 V secondary, 1 Amp
T2 – 240 V primary, 4200 V secondary, 500 mA
T3 – General Electric Catalog no. 9T92Y14, 0-240 V
T4 – 0-140 variable transformer
T5 – 120 V primary, 7.5 V secondary, 23 Amps
D1 – Silicon rectifier, Slater Elec. Co., Part No. SLA08-2, 400 mA, 8000 PRV (Ref. 2)
D2 – Silicon diode 0.5 Amp, 75 PRV
RFC1 – Barker and Williamson FC-30A
RFC2 – kW HF choke
RFC3, RFC4 – Ohmite Z50 VHF choke
Filter capacitors – use at least two, 4 uF 4000 V dc working voltage
S1 – 2 section, 3 position small ceramic
S2 – 2 section, 3 position heavy-duty ceramic (surplus)
S3 – 1 section, 3 position heavy-duty ceramic (surplus)
Blower – see text
Rf ammeter – General Electric from Command Set, 0-10 Amp
Chassis – 17" x 20" x 4", made up of two 17" x 10" x 4" chassis fastened together with machine screws
Chassis – 17" x 20" x 2", made up of two 17" x 10" x 2" chassis fastened together with machine screws

Table 2. Component list.

the noise bridge) to the band center or other frequency at which it is desired to resonate the amplifier input network. Set the bridge to 50 Ohms and rock C1 and C2 to minimum dip of the receiver S-meter. Repeat the procedure for the 40 and 20 meter input networks.

Connect the noise bridge ANT terminal to the antenna connection (J2) of the amplifier. Apply 28 V dc to RL1 to actuate RL2 and RL3, or close RL2 and 3 mechanically so that S2B is connected to J2. Set S2 to 80 meters. Set the receiver to the band center or other frequency at which it is desired to resonate the 80 meter output network. Set the bridge to 50 Ohms and rock C9 and C10 to the minimum dip of the receiver S-meter. Tune the 40 and 20 meter networks in a similar manner.

Connect the antennas to the antenna tuner and the bridge ANT terminal to J3. Set the bridge to 50 Ohms and S3 to the 20 meter position. Tune C15 and C16 for a dip. Repeat for the 40 meter antenna. This completes the tuning procedure. Remove the 100 and 3000 Ohm resistors. Replace the bottom cover, replace the amplifier in the cabinet, and connect up all cables and the cooling hose.

Operation

In operating the amplifier, set S1, S2, and S3 to the desired band, check that the two variacs are turned to zero, turn on the power, and bring the filament up slowly to 7.5 volts. When the 60 second time delay actuates and the red panel light comes on, turn up the plate variance to 3700 volts reading of the panel voltmeter (HV will drop to 3600 under load). At this point, the plate and grid current meters will read zero. Actuate the VOX relay by grounding the VOX lead to the exciter. Grid current will read zero and plate current will read about 55 mA. With the exciter in the CW tune position, turn up the exciter drive control until the plate current meter of the amplifier reads 260 mA and grid current reads 50 mA. Allowing for feedthrough power from input to output, the input power to the plate circuit is now just under one kW for CW operation.

Grid current for single tone input runs 70 mA with plate current at 280 mA. The SSB input for this condition is 1 kW PEP. To correctly adjust the amplifier for 2 kW PEP, a two tone generator is required. If you do not have a generator available, adjust the amplifier for 2 kW PEP input by talking into the microphone at your normal voice level and distance from the microphone and increasing the drive until the plate meter peaks reach 265 mA. Grid current peaks will be about 60 mA for plate current peaks of 265 mA. The actual current peaks are approximately double the values of the meter readings. Table 1 shows maximum tube ratings at a plate voltage of 3600 V dc. ■

References

[1] The Cool Amp Company, 8603 S.W. 17th Avenue, Portland, Oregon 97219.

[2] R. E. Goodheart Co., Inc., Box 1220GC, Beverly Hills, California 90213.

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John J. Marlatt K7AGI
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Build a $2 Drill

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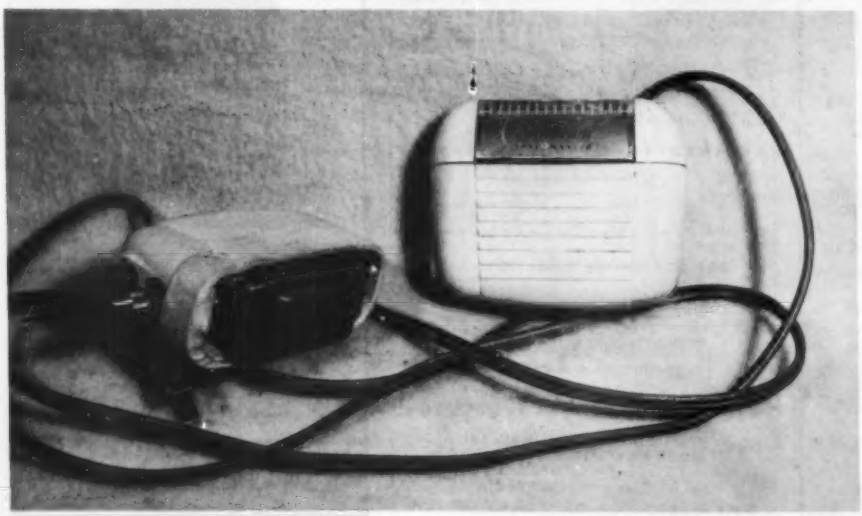
If you need to drill small holes, this little motor is handy and inexpensive. It easily drills through 1/8" of bakelite, fiberglass or aluminum. It beats putting a #60 (.040") drill in a motor and immediately breaking the bit. Small sizes need speeds up to 7000 rpm or more.

The following describes conversion of Sunbeam "Shavemaster" razor motors into useful hand-held drills. Model "W" seems to be plentiful at local salvage stores of Goodwill Industries, St. Vincent dePaul and Volunteers of America, at prices from 15¢ to 50¢.

The procedure is as follows: Remove two screws from the bottom of the plastic case and lift out the works. Brush off any dust and clippings. Remove the retaining washer from connecting rod and take off the nylon rod. Remove 4 screws and discard all oscillating shaver parts, but retain the large diecast plate.

Unsolder two wires from ac power input post.



Remove two brush holder clips, keeping your fingers over the holes to prevent the brush springs from flying away. Remove the 4 hex nuts holding the end bell to the motor frame. Slide out the armature.

Carefully remove the two motor brushes. If they are less than ¼" in length they should be replaced (shaver repair stores have them). Brush out carbon dust, etc.

Place the armature in a vise and unscrew the crank (counterclockwise). Discard the crank. Run a 4-40 tap into the hole in the shaft. This is preferably done in a metal lathe but can be successfully performed by hand. On the reverse end of shaft, saw a screwdriver slot with a miniature hacksaw blade. File off any burrs left by the saw.

Place a drop of oil on each bearing and, if there are spacer washers on the shaft, put at least one on the commutator end for a thrust bearing. Reassemble the motor and solder the wires back on power input post. Now, test the motor.

Take the plate saved from shaving mechanism and saw off the bosses or projections that held the shaft. File it smooth, and round off all corners and edges as you hold this in your hand after assembly. Replace on the motor frame.

Drop the motor back in the plastic case and measure points on the housing even with ends of the armature shaft. Drill ¼" holes in each end. Enlarge the crank opening to ½", preferably with a tapered reamer, as it is very easy to split plastic with a large drill.

Obtain a steel 4-40 machine screw about one inch long, and cut off the head, leaving it about ¾" in length. Smooth the threads in a 4-40 die if possible. Screw this into armature shaft.

If you have the original power cord with the special

plug, put the motor back in the case. If the cord is not available, use an ordinary lightweight zip cord and solder it onto power post.

Purchase from your local hobby store a No. 22B-C X-Acto drill chuck adapter. If not available in your area, you can order the chuck from X-Acto Corp., 48-31 Van Dam St., Long Island City, New York 11101. This size chuck accommodates No. 63-50 drills.

Place the chuck shaft in a 3 jaw chuck on a metal lathe and tap it with a 4-40 tap about 3/8". This can possibly be done by hand, but risks going in crooked and breaking the tap.

File two flat places on opposite sides of the shaft where the X-Acto name is stamped. I made a small wrench from a scrap of 1/8" steel to fit the flats. Screw the chuck onto the armature shaft, holding it with a screwdriver in the slot. Put a small drill in the chuck and tighten it with your fingers, holding the chuck shaft with a wrench.

Plug it in and put it to work. This gadget is quite useful for cleaning out solder from holes in circuit boards which have had parts removed.

If desired, a push-button switch can be made using the hole over the power post. This is not easy, but does make it more convenient. It is necessary to make a plastic push-button on a lathe. Drill a hole in it to slip over the concentric power post. I took contacts off a small discarded relay and soldered them onto the power post terminals, so that the button pressed the contacts together. Then one wire to the motor is disconnected from the post and goes directly to the power cord (which comes in from a new hole drilled in the opposite end of the plastic case). The other wire goes in series with the switch contacts. ■

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Unique Power Supply Tester

- - uses a load bank

James C. Chapel W9HDA
2349 Wiggins Avenue
Springfield IL 62704

The first question asked might be, "What is a load bank?" The term is taken from the electrical power industry to explain a device to simulate a load on various power sources in order to check the load performance of those sources. In this case, the article covers the building of two simple load banks or dummy loads for small and rather large sized dc power supplies that are finding present usage with hams and hobbyists. This article shows how it can be done economically and with readily available parts. Also, using the basic ideas presented here, load banks for most any type of low voltage power supply can be built.

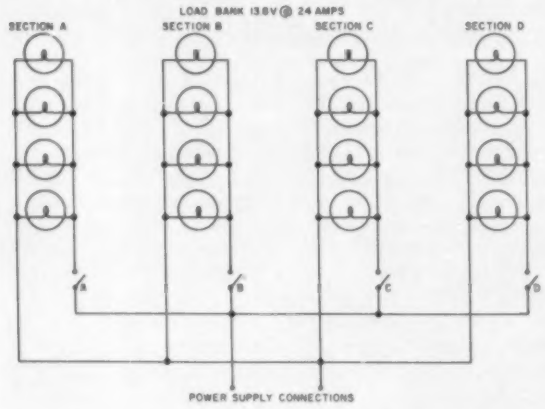
In order to properly evaluate the performance of a power supply (whether home built or commercially built), the supply must be tested at various degrees of loading – that is, no load, half load, full load, etc. The major requirement for a suitable load bank is that it be capable of providing these various load conditions. Thus, several load elements are required, or at least one large variable element is required, in order to cover several different load conditions. These load elements would typically be large fixed or variable power resistors. If the power supply is of any size, the load elements have to be of high power rating (10, 25, or even 50 Watt). A look at a parts catalog will show that power resistors get expensive as the power rating goes up and the different ohmic values available go down. Also, power resistors present the problem of how to get rid of the heat and how to conveniently mount the resistors.

Instead of using the regular power resistor in the design of these load banks, automotive bulbs and pilot lamps were used. These are readily available at auto parts stores, electronic parts houses, and even department store electrical parts sections. Bulbs are selected on the basis of voltage and current requirements and typically work out very nicely in regard to both values. The problem of power dissipation is very minimal and mounting can be very simple. With the load elements decided, the actual construction of the load bank can begin.

The first load bank requirement was for a rather large 13.8 volt dc 24 Amp dc supply. It was decided to check one third, two thirds, full load, and 133% of full load. Voltage and ripple were observed under the various load conditions. The #1073 automotive bulb was selected with a nominal rating of 12.8 volts @ 1.8 Amps. Typical cost is less than 30¢. Since the power supply voltage was to be a volt higher, the current at that voltage was approximated to be about 2 Amps. This is a fine feature of these bulbs – the voltage can be increased up to 20% of nominal rating without any problem in this application.

The bulbs were arranged in four groups or sections of four each. See Fig. 1 for the circuit diagram. Each group presents a load of about 8 Amps at nominal voltage to simulate four load conditions. In order to keep costs down and construction simple, the wires consisting of #14 TW wire were soldered directly to the bulb bases. The start and end of each section wire were wrapped around a nail which was driven into the wooden base board. This eliminated expensive sockets and, after all, a load bank is not a device that is normally on display in the shack.

Since this load bank was to be used for a considerable



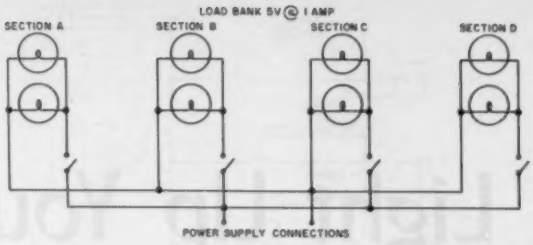
Section	Load	Current in Amps @ 13.8 volts
A	33%	8
A & B	66%	16
A, B, & C	full	24
A, B, C, & D	133% of full	32

Fig. 1. All bulbs #1073. All wire #14 TW. A, B, C, D – 10 Amp relay contacts or 10 Amp switches (optional since connections can be made directly).

amount of testing and since four surplus relays were available, each load section was wired through relay contacts as shown in the diagram. Any combination of loading can be quickly selected. This extra feature can be eliminated with just the use of solder connections or switches with proper current rating. The switching feature is certainly handy if considerable testing is to be done, but adds considerably to the parts cost if the junk box is not well stocked.

The second load bank was for a much smaller dc power supply with a rating of 5 volts @ 1 Amp. Following the same design features of the previous load bank, a #502 bulb was selected as load element in four sections with two bulbs in each section, giving 30%, 60%, 90%, and 120% of full load. Since the current requirements were much less, about 0.3 Amps per section, regular #22 solid hookup wire was directly soldered to the bulb bases and toggle switches (or even slide switches) used for controlling the load sections. A small wood base board was again used for mounting the bulbs and wiring with a small 1/8 inch pressed board panel (nailed to the edge) to support the switches. This supply is most useful for checking logic power supplies used with ICs. Overload or current foldover characteristics can be checked on supplies designed with that feature. See Fig. 2 for the circuit.

There are many advantages to these simple load banks besides the cost and ease of construction. The bulbs present a large amount of light under full load to leave no doubt that the supply is working. Also, there are no burn marks from power resistors on the workbench or, even worse, the dining room table. Buying the bulbs by the box reduces cost, and automotive type bulbs are readily available, even at gas stations.



Section	Load	Current in Amps @ 5 volts
A	30%	0.3
A & B	60%	0.6
A, B, & C	90%	0.9
A, B, C, & D	120% of full	1.2

Fig. 2. All bulbs #502. All wire #22 solid. A, B, C, D – 0.3 Amp switches.

The purists may argue that the bulb is not a constant load resistance due to the filament characteristics. This sudden heavier than normal load when voltage is first applied to the bulb is very short in duration and provides an even stricter load test of the supply being tested.

The load bank ideas presented here can be extended to other sizes and types of load banks by changing the bulb types and the number of bulbs in a section, and even the number of load sections.

These load banks have been used to check voltage and ripple conditions on a variety of home brew and commercial supplies. The cost is certainly cheap if proper shopping around is done on the choice and source of bulbs. ■

Gene Brizendine W4ATE
600 Hummingbird Dr., S.E.
Huntsville AL 35803

Instant Spares

-- for those after-hour repairs

The time required to restore failed equipment depends often on locating the spares. The simple scheme described insures that replacement plug-in devices are always available at the exact point of need.

Fig. 1. Self-storage of spare TO-5 devices. (a) Bonding with transparent tape. (b) Bonding with a common heat sink.

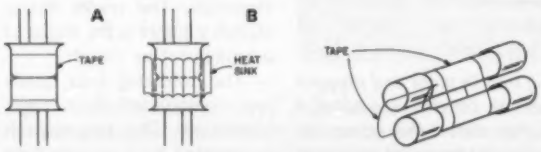


Fig. 2. Cartridge-type fuses, bonded with transparent tape.

The method is to combine the operating unit and an identical spare into one double-ended package. The example shown in Fig. 1(a) joins a pair of identical transistors back-to-back, using transparent tape, so that identifying data remains visible. TO-cased devices requiring heat sinking may be joined using only the heat sink as in Fig. 1(b).

When equipment failure occurs, the plug-in packages are simply flipped over one at a time, to isolate the problem to the device or other components.

Equipment using several identical plug-in units may not justify the cost of a spare for every socket, and a lesser quantity would be adequate.

Many other plug-in units, ranging from DIP ICs, automobile fuses and flashers, to household plug fuses and fluorescent starters lend themselves to this sparing technique, as suggested in Figs. 2 and 3. ■

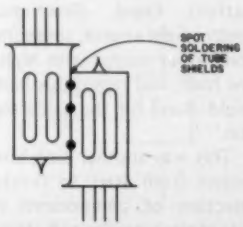


Fig. 3. Method of storing spare miniature vacuum tube.

Light Up Your Bench

-- versatile power distribution system

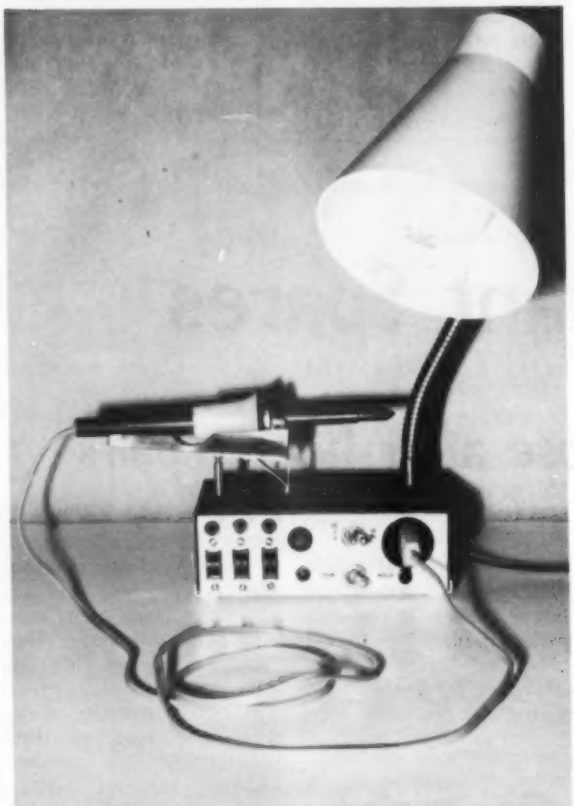
Joseph M. Frezza WA3VGT
499 Easton Road
Horsham PA 19044

My workbench becomes a mass of ac cords just about every time I dig into a project, leaving limited work space. In the middle of the confusion, I entertain the thought of constructing an ac receptacle that will be portable on the bench and at the same time have some fuse protection for equipment under repair or construction.

Another nagging workbench item is the soldering iron. It would be difficult to determine how many times it sat on the bench cooking for days, or how many times I accidentally burned myself or damaged material lying on the workbench.

Well, thanks to *73* and Arny WB4FDQ, I got off dead center and built my magic box. Now I have a portable switched 3 outlet ac power source with 2 of the outlets fused, directional control light source, soldering iron power source with high/low heat, and removable heat shield stand for the soldering iron.

This was another junk box project from start to finish. Selection of components is not critical as long as they can handle 115 volts at 5 to 9 Amps. In addition to the basic tools, a small punch set and nibbler were needed. If you don't have access for borrowing one, Lafayette Radio usually has them in stock at a modest price.



Workbench magic box with soldering iron in place and plugged in. Although the switches and fuses are on the rear panel, I elected to locate the indicator lights above the respective outlets. If the receptacle for the soldering iron was relocated to the left side panel, the cord might be easier to handle.

The project began with Arny's article and circuitry in *73*'s July issue. I did replace his S2 switch with a DPDT switch and eliminated the number one position as he suggested. In addition, I utilized a three prong safety cord to ground the case.

Fig. 1 is the schematic circuitry of the magic box. I decided I wanted a few luxuries not really needed. A neon indicator light is always on as long as the box is plugged in. The indicator lights for outlets 2 and 3 are wired behind the fuses to indicate when a fuse is blown. If the builder is working with very low current fuses, the indicator light load should be placed in front of the fuse so as not to increase the current drain at the outlet.

My aluminum case was 3" x 5" x 2" and was used in several earlier projects. I tried to place all the wiring in the lower half to simplify construction. The cradle microswitch support is the frame of a broken rocker switch.

The soldering iron cradle was constructed from sheet aluminum. The microswitch is operated by a plunger-type rear support. A standoff

Internal parts placement should allow working space for top cover microswitch assembly. The light unit had its own power switch, eliminating the need for a switch on the chassis.

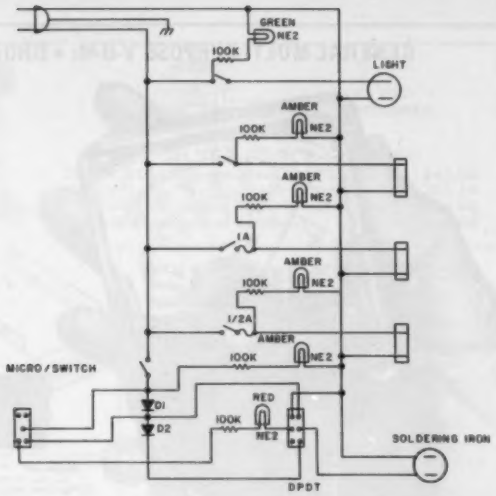


Fig. 1.

spacer with bolt for plunger works well. The plunger was designed with 1/8" travel, allowing plenty of movement to insure switch operation and still protect from excess weight being placed on the cradle.

The light source is an old desk lamp fixture. Placement of the light should allow free access of the soldering iron for right- and left-handed users. A high intensity light unit would make a better light source.

Parts placement is not critical.

With a little effort, your magic box can be made to look store-bought. Remove all dirt and grease from aluminum and use a good primer base. Aerosol lacquer spray paint is easily found in auto supply houses and hardware stores. I used rub-on lettering that I bought at the ham store and then sprayed with a clear lacquer for added protection. Painting and labeling should be done before component assembly. Allow a day or two after painting for finish to reach maximum set.

Don't let the simple wiring circuitry mislead you into not checking before attaching to ac line. The accompanying photos were supplied by Don Smith WA3VEA.

The completed project will provide invaluable service on or off the workbench. ■

Hang Ten

-- relay slow release circuit

John Skubick K8ANG
1040 Meadowbrook
Warren OH 44484

These are old phone company central office equipment circuits that are still used in today's modern electronic exchanges. Perhaps you may need only a slight or a very slight amount of delay-release in a relay(s) control circuit of yours. One way is to re-tension the relay springs by bending or "kinking." This practice (also used in C.O. equipment) is subject to the aging process and, with time, will change its characteristics. Here are two simple ways to have *stabilized*, short-delayed release in a relay.

The circuit in Fig. 1 gives very slight delays. The amount of delayed release is subject to the amount of current drawn by the coil and the coil's resistance.

Want a little more delayed release time for a given coil? Try Fig. 2. This one can be discernible to the naked eye in delayed releasing, dependent upon the coil current and resistance. Note the diode polarity; otherwise, you may end up with a short circuit!

"Ah-ha," you say, "but Fig. 2 is used to suppress the coil's inductive voltage kick-back, for solid state or contact protection." That is correct! This is why sometimes electronic keyers can't follow high-speed sending when using reed relay outputs.

Maybe this bit of info will help solve your "knotty" relay timing problem(s)? ■

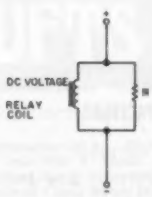


Fig. 1. Simple, compact, dc relay delay circuit. Shunting resistor should be five times the dc resistance of the relay coil. Wattage rating of resistor equals ¼ the power (in Watts) drawn by coil.

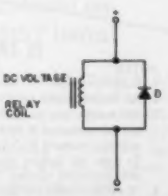


Fig. 2. Note polarity of shunt diode! Also observe diode's piv rating.

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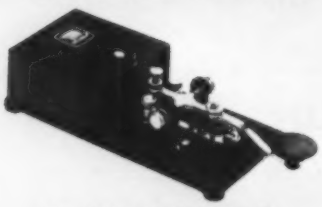

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75-40 HD (SP)	75/40	57.50	40/1.12	66/20.1
75-20 HD	75/40/20	66.50	44/1.23	66/20.1
75-20 HD (SP)	75/40/20	66.50	44/1.23	66/20.1
75-10 HD	75/40/20/15/10	74.50	48/1.34	66/20.1
75-10 HD (SP)	75/40/20/15/10	74.50	48/1.34	66/20.1
**80-10 HD	80/40/20/15/10	76.50	50/1.40	69/21.0

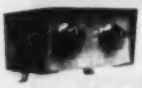
NOTES
1. Models prefaced '**' will be available 1/77.
2. All models above are furnished with crimp/solder lugs.
3. All models can be furnished with a SO-239 female coaxial connector at additional cost. The SO-239 mates with the standard PL-259 male coaxial cable connector. To order this factory installed option, add the letter 'A' after the model number. Example: 40-20 HD/A.
4. 75 meter models are factory tuned to resonate at 3950 kHz. (SP) models are factory tuned to resonate at 3800 kHz. 80 meter models are factory tuned to resonate at 3850 kHz. See VSWR curves for other resonance data.

NO TRAPS—NO COILS— NO STUBS—NO CAPACITORS

MOR-GAIN HD DIPOLES . . . • One half the length of conventional half-wave dipoles. • Multi-band, Multi-frequency. • Maximum efficiency – no traps, loading coils, or stubs. • Fully assembled and pre-tuned – no measuring, no cutting. • All weather rated – 1 KW AM, 2.5 KW CW or PEP SSB. • Proven performance – more than 15,000 have been delivered. • Permit use of the full capabilities of today's 5-band xcvrs. • One feedline for operation on all bands. • Lowest cost/benefit antenna on the market today. • Fast QSY – no feedline switching. • Highest performance for the Novice as well as the Extra-Class Op.

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

SST T-1 RANDOM WIRE ANTENNA TUNER



All band operation (160-10 meters) with most any random length wire. 200 Watt power capability. Ideal for portable or home operation. A must for Field Day. Size: 2 x 4-1/4 x 2-3/8. Built-in neon tune-up indicator. Guaranteed for 90 days. Compact — easy to use. Only $29.95.

ASTATIC MICROPHONES

SILVER EAGLE — $69.95

T-UG8-D104, transistorized	$48.60
T-UG9-D104, "Golden Eagle," transistorized	$95.40
T-UG9-D104, "Silver Eagle," transistorized	$69.95
UG-D104, ceramic or crystal	$42.60

Model 200 V

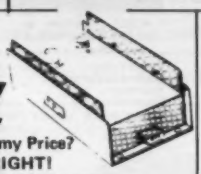
Model 210

Model 220

CES Touch Tone Pads

- Model 200V — acoustic coupling. $59.95
- Model 210 — for mounting on walkies or hand-helds. $54.95
- Model 220 — CES can now offer you a TOUCH TONE back for Standard Communications hand-held radios. This is the complete back assembly with the TOUCH TONE encoder mounted and ready to plug into the private channel connector. Also included is a LED tone generator indicator and an external tone deviation adjustment. $74.95.

talk power by TPL



TPL for an Economy Price? THAT'S RIGHT! introducing the ECONO-LINE

Model	Input	Output	Typical	Frequency	Price
702	5-20W	50-90W	10 in/70 out	143-149 MHz	$139.00
702B	1-4W	60-80W	1 in/70 out	143-149 MHz	$169.00

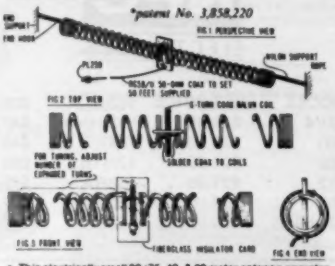
Now get TPL COMMUNICATIONS quality and reliability at an economy price. The new Econo-Line gives you everything that you've come to expect from TPL at a real cost reduction. The latest mechanical and electronic construction techniques combine to make the Econo-Line your best amplifier value. Unique broad-band circuitry requires no tuning throughout the entire 2-meter band and adjacent MARS channels. See these great new additions to the TPL COMMUNICATIONS product line at your favorite amateur radio dealer.

For prices and specifications please write for our Amateur Products Summary! FCC type accepted power amplifiers also available. Please call or write for a copy of TPL's Commercial Products Summary.

SLINKY! $43.95 Kit

A LOT of antenna in a LITTLE space

New Slinky® dipole* with helical loading radiates a good signal at 1/10 wavelength long!



• This electrically small 80/75, 40, & 20 meter antenna operates at any length from 24 to 70 feet • no extra balun or transmatch needed • portable—erects & stores in minutes • small enough to fit in attic or apartment • full legal power • low SWR over complete 80/75, 40, & 20 meter bands • much lower atmospheric noise pickup than a vertical and needs no radials • kit includes a pair of **specially-made 4-inch dia. by 4-inch long coils**, containing 335 feet of radiating conductor, balun, 50 ft. RG58/U coax, PL259 connector, nylon rope & instruction manual • now in use by US Dept. of State, US Army, radio schools, plus thousands of hams the world over

FT-101E TRANSCEIVER

YAESU

FT 301	160M-10M Transceiver — 200 WPEP	$769
FP 301 DIG	160M-10M Transceiver — 200 WPEP	935
FP 301	AC Power Supply	125
FP 301 CID	AC P.S. w/Clock and CW ID	209
FRG-7	General Cov. Synthesized Receiver	299
QTR-24	Yaesu World Clock	30
FT-101-E 160-10M	XCVR W/Processor	729
FT-101EE 160-10M	XCVR W/O Processor	649
FT-101EX 160-10M	XCVR W/O Processor AC Only, Less Mike	589
FL-2100B	Linear Amplifier	399
FTV-650B	6M Transverter	199
FTV-250	2M Transverter	199
FV-101B	External VFO	109
SP-101B	Speaker	22
SP-101PB	Speaker/Patch	59
YO-100	Monitor Scope	199
YD-844	Dynamic Base Mike	29
FA-9	Cooling Fan	15
MMB-1	Mobile Mount	19
RFP-102	RF Speech Processor	79
XF-30C	600 Hz CW Filter	40
FR-101S SOLID STATE	160-2M/SW RCVR	489
FR 101 DIG SOLID STATE	160-2M/SW RCVR	599
FT 301S	160-10M 40WPEP	559
FT 301S	160-10M 40WPEP Digital	765

Accessories:		
FC-6	6M Converter	24
FC-2	2M Converter	25
FM-1	FM Detector	20
-	Aux/SW Crystals	5
XF-30B	AM-Wide Filter	40
XF-30C	600 Hz CW Filter	40
XF-30D	FM Filter	49
SP-101B	Speaker	22
FL-101 SOLID STATE TRANSMITTER	160-10M	525
Accessories:		
RFP-101	RF Speech Processor	79
MONITOR/TEST EQUIPMENT		
YC 500 J	500 MHz (10 PPM) Counter	249
YC 500 S	500 MHz (1 PPM) Counter	365
YC 500 E	500 MHz (0.02 PPM) Counter	489
YO-100	Monitor Scope	199
YP-150	Dummy Load/Watt Meter	69
YC-601	Digital Readout (101/401 series)	169
VHF FM & SSB TRANSCEIVERS		
FT-620B	6M AM/CW/SSB	365
FT-221	2M AM/FM/CW/SSB	629
Accessories:		
MMB-4	Mobile Mount (FT-620B, FT-221)	19

TUFTS

Radio Electronics

209 Mystic Avenue
Medford MA 02155
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FREE Gift With Every Order!

Name _____ Call _____

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☐ Check enclosed

☐ BankAmericard ☐ MasterCharge ☐ American Express

Credit card # _____ Interbank # _____

Signature _____ Card expiration date _____

Cash orders over $1200 deduct 5%. No other discounts offered. All sales final.

MasterCharge American Express BankAmericard accepted on MOST items!

Prices FOB Medford MA. All units can be shipped UPS. MA residents add 5% sales tax. Minimum $3.00 for shipping & handling on all orders. $10.00 merchandise minimum please.

TUFTS RADIO CATALOG TUFTS RADI

HAM RADIO / MOBILE COMMUNICATIONS

THOMSON-CSF
NPC
ELECTRONICS

MODEL	NET PRICE		
12V4	$19.95	103R	$39.95
600	$20.50	*13 HM 4	$41.95
102	$24.95	104R	$49.95
612	$27.95	12/115	$69.95
107	$28.95	108RA	$79.95
12 HM 4	$29.95	108RM	$99.95
		109R	$149.95

MODEL 12HM4

NPC 2.5 Amp Regulated Power Supply. Solid State. Short Circuit Protected.

Low cost regulated power supply quietly converts 115 volts AC to 13.5 volts DC ±200 millivolts. 1.5 amps continuous, 2.5 amps reg. Ideally suited for operating mobile CB transceivers in your home or office base station.

ALSO! Available as 13 HM 4 with built-in loudspeaker.

	TYPICAL	MAXIMUM
Output Voltage	13.5 ±.5VDC	14VDC
Continuous Current	1.5 Amp	
Regulation	2.5 Amp	
Ripple/Noise	5 mV RMS	10 mV RMS

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 107

NPC 4 Amp Power Supply, 6 Amp Max. Solid State. Overload Protected

Functions silently in converting 115 volts AC to 12 volts DC. 4 amps continuous, 6 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette player or car radio in a home or office.

Continuous Current (Full Load)	4 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	10,000 uF
Ripple (Full Load)	.5 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 5 lbs.

MODEL 103R

NPC 4 Amp Regulated Power Supply. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 2.5 amps continuous and 4 amps max. Ideally suited for applications where no hum and DC stability are important such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	2.5 Amp	
Current Limit	4 Amp	
Current Foldback	1 Amp	

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

MODEL 109R

NPC 25 Amp Regulated Power Supply. 4-Way Protected. Output Voltage and Current Meters.

Extra heavy-duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 10 amps continuous, 25 amps max. All solid state. Features dual current overload, overvoltage and thermal protection. Ideally suited for operating mobile Ham radio and linear amplifier in your home or office. Excellent bench power supply for testing and servicing of mobile communications equipment.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	50 mV	100 mV
Ripple Noise	5 mV RMS	10 mV RMS
Transient Response	25 uSec	
Current Continuous	10 Amp	
Current Limit	26 Amp	
Overvoltage Protection	14.5 V	15 V
Thermal Overload	180°F	

Case: 4¾" (H) x 9" (W) x 8½" (D). Shipping Weight: 15 lbs.

MODEL 12V4

NPC 1.75 Amp Power Supply. 3 Amp Max.

Functions silently in converting 115 volts AC to 12 volts DC. Ideally suited for most applications including 8-track stereo, burglar alarm, car radio and cassette tape player within power rating.

Continuous Current (Full Load)	1.75 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.4 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4" (W) x 5¼" (D). Shipping Weight: 3 lbs.

MODEL 108RM

NPC 12 Amp Regulated Power Supply. Solid State. 3-Way Protected. Current Meter.

This heavy duty unit quietly converts 115 volts AC to 13.6 volts DC ±200 millivolts. 8 amps continuous, 12 amps max. All solid state. Features dual current overload and overvoltage protection. Ideally suited for operating mobile Ham radio 2 meter AM-FM-SSB transceivers in your home or office. Can also be used to trickle-charge 12 volt car batteries.

	TYPICAL	MAXIMUM
Output Voltage	13.6 ±.2VDC	13.6 ±.3VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	8 Amp	
Current Limit	12 Amp	
Current Foldback	2.5 Amp	
Overvoltage Protection	14.5 V	15 V

Case: 4½" (H) x 7⅞" (W) x 5½" (D). Shipping Weight: 9.5 lbs.

ALSO AVAILABLE AS MODEL 108RA WITHOUT METER AND OVERVOLTAGE PROTECTION.

MODEL 104R

NPC 6 Amp Power Supply Regulated. Solid State. Dual Overload Protection.

Converts 115 volts AC to 13.6 volts DC ±200 millivolts. Handles 4 amps continuous and 6 amps max. Ideally suited for applications where excellent DC stability is important, such as CB transmission, small Ham radio transmitter, and high quality eight-track car stereos. Can be used to trickle-charge 12 volt car batteries.

	MAXIMUM	TYPICAL
Output Voltage	13.6 ±.2 VDC	13.6 ±.3 VDC
Line/Load Regulation	20 mV	50 mV
Ripple/Noise	2 mV RMS	5 mV RMS
Transient Response	20 uSec	
Current Continuous	4 Amp	
Current Limit	6 Amp	
Current Foldback	2 Amp	

Case: 3½" (H) x 5¼" (W) x 6½" (D). Shipping Weight: 6 lbs.

MODEL 102

NPC 2.5 Amp Power Supply. 4 Amp Max. Solid State. Overload Protected.

Functions silently in converting 115 volts AC to 12-volts DC. 2.5 amps continuous, 4 amps max. Enables anyone to enjoy CB radio, car 8-track cartridge, cassette tape player or car radio in a home or office.

Continuous Current (Full Load)	2.5 Amp
Output Voltage (No Load)	16 V max
Output Voltage (Full Load)	12 V min
Filtering Capacitor	5,000 uF
Ripple (Full Load)	.6 V RMS
Short Circuit Protection	Thermal Breaker

Case: 3" (H) x 4¾" (W) x 5¾" (D). Shipping Weight: 4 lbs.

	12 VDC 1N		14 VDC 1N
Output Voltage (No Load)	115 V RMS		130 V RMS
Output Voltage (Full Load)	100 V RMS		115 V RMS
Frequency (No Load)	58 Hz		66 Hz
Frequency (Full Load)	54 Hz		62 Hz
Power Continuous		200W	
Power Peak		240W	
Parallel Connection		350W	

All Values Are Typical

MARINE & RV

MODEL 12-115

NPC 12-115 Solid State Inverter, 200 W. Parallel Connection for Higher Power up to 350 W.

Converts 12 volts DC to 115 volts AC @ 60 Hz output. 200 watts continuous operation with peak power up to 240 watts. All silicon semiconductors assure high reliabiltiy at excessive ambient temperatures. The output voltage is a square wave. The inverter is not recommended where high transients are not tolerable.

The 12-115 allows you to have AC house current in your boat, car, truck, camper, house trailer, or houseboat. Will operate small household appliances, T.V., hand tools, electric shaver, AC radios, and lights within power rating. Built-in overload protection.

Case: 4½" (H) x 7⅛" (W) x 5½" (D). Shipping Weight: 7 lbs.

MODEL 612

Model 612 Power Converter

NPC 612 converts 6 volt negative ground or 12 volt positive ground electrical systems to 12 volt negative ground operation. Provides full 3 amp continuous power. The inexpensive solution for installing car radios, stereo and cassette tape players, in vehicles with 6 volt negative ground or 12 volt positive ground systems.

Case: 2¾" (H) x 3" (W) x 5" (D). Shipping Weight: 1 lb.

● Handle full 200 watts ● low-low V.S.W.R. ● Deliver 3 dB gain and more! ● Pick the one that best fits your needs:

Larsen Kūlrod® Antennas

MAGNETIC MOUNT
stays put even at 100 mph!

MM-JM-150 for 144 MHz use
MM-JM-220 for 220 MHz use
MM-JM-440 for 440 MHz use
} Only $38.50 complete

TRUNK LID MOUNT
No holes and low silhouette too!

TLM-JM-150 for 144 MHz use
TLM-JM-220 for 220 MHz use
TLM-JM-440 for 440 MHz use
} Only $38.50 complete

And 1/4 wave antenna for trunk and magnetic mount – $18.50

ROOF or FENDER MOUNT
Goes on quick and easy in 3/8" or 3/4" with fewest parts.

JM-150-K for 144 MHz use
JM-220-K for 220 MHz use
JM-440-K for 440 MHz use
} Only $31.50 complete

And 1/4 wave antenna for roof and fender mounts $11.50

Above antennas all complete with mounting hardware, coax, connector plug, allen wrench and complete instructions.

Model 372 – $27.50

model 372 CLIPREAMP

Get maximum legal modulation without danger of splatter. Solid-state speech preamplifier and clipper for transmitters, public-address systems, and tape recorders needs no external power.

• specifications

Input Impedance	100,000 ohms
Input Levels	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Ouput Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	3-3/4" x 3" x 4-1/2"
Shipping Weight	7 oz.
Connectors	Terminal strip

COAXIAL ANTENNA CHANGEOVER RELAY

model 377

Model 377 – $17.95

Economical and reliable. Can be operated from VOX circuit for completely automatic operation or from PTT or manual T/R switch. Receiver input is automatically grounded when the relay is in the Transmit position. Wide AC operating voltage range and low operating current.

• specifications

Power Rating	1000 watts CW (2000 watts SSB)
VSWR	Less than 1.15:1, DC to 150 MHz
Power Requirements	0.015 Amperes, 48 to 130 volts AC
Connectors	UHF Type SO-239
Dimensions	3-1/2" x 1-1/2"
Shipping Weight	1 lb.

UNIVERSAL HYBRID COUPLER II PHONE PATCH

model 300 2W and model 300 1W

Connect your station to the telephone lines. Five switch-selectable modes give complete flexibility for patching the station to the line and for tape recording and playback to or from the line or the station. The hybrid circuit provides for effortless VOX operation of the phone patch. A built-in *Compreamp* speech preamplifier/limiter (in Model 300 2W) increases the level of weak phone signals and also prevents overmodulation when the local telephone is used as the station microphone. (The *Compreamp* also functions as a preamplifier/limiter with the station microphone, if desired.)

• specifications

Inputs from:	
Line	600 ohms
Receiver	4 ohms
Microphone	High impedance (50,000 ohms) crystal or dynamic
Tape Recorder	4 ohms
Outputs to:	
Transmitter	50,000 ohms
Receiver Speaker	4 ohms
Tape Recorder	0.5 megohm
Size	6-1/2" x 7-1/2" x 3"
Shipping Weight	5-1/2 lbs.
Power	9-volt battery, Burgess 2U6 or equivalent
Connectors	Phone

Model 300 2W with *Compreamp* – $125.00

Model 300 1W without *Compreamp* – $85.00

BARKER & WILLIAMSON, INC.

Model 359 – $37.50

Increase your transmitter's effective speech power up to four times. Or use it with your tape recorder or public address system for improved performance. This two-stage, transistorized Audio Preamplifier/Limiter can be used with all types of transmitters. Powered by a long-lasting dry-cell battery—no external power needed. Installs without any wiring changes in your transmitter. Just connect the *Compreamp* between your microphone (50,000-ohm dynamic or high-impedance ceramic) and your transmitter's microphone input connector. Front-panel rocker switch lets you bypass the *Compreamp* when you want to. Compression level is adjustable, too.

• specifications

Input Impedance	100,000 ohms
Input Level	5 millivolts to 20 millivolts
Voltage Gain	10 dB
Output Level	60 millivolts
Output Impedance	50,000 ohms
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	3-3/4" x 3" x 4-1/2"
Shipping Weight	6-1/2 oz.
Connectors	Terminal strip

COAXIAL SWITCHES AND ACCESSORIES

for antenna selection and RF switching

These high-quality switches have set the standard for the industry for years. Ceramic switches with silver-alloy contacts and silver-plated conductors give unmatched performance and reliability from audio frequencies to 150 MHz.

B&W coaxial switches are designed for use with 52- to 75-ohm non-reactive loads, and are power rated at 1000 watts AM, 2000 watts SSB. Connectors are UHF type. Insertion loss is negligible, and VSWR is less than 1.2:1 up to 150 MHz.

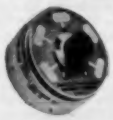
Crosstalk (measured at 30 MHz) is -65 dB between adjacent outlets and -80 dB between alternate outlets.

Models are available for desk-, wall-, or panel mounting, and with or without protective grounding of inactive outputs. Radial (side-mounted) connector models can be either wall or panel mounted; axial (backplate-mounted) connector models are for panel mounting only, save panel space.

Use the selector chart below to choose the models you need.

Model 560A

Model 590


Model 590G

Model 551A

Model 592

Model 556

COAXIAL SWITCH SELECTOR CHART

Model	PRICE	Outputs	Connector Placement	Mounting: Panel	Mounting: Wall	Mounting: Desk	Automatic Grounding	Dial Plate	Remarks
375	18.95	5	Axial	x			x	Supplied	PROTAX switch. Grounds all except selected output circuit.
376	18.95	5	Radial	x	x		x	Supplied	PROTAX switch. Grounds all except selected output circuit. Sixth switch position grounds *all* outputs.
560A	14.00	5	Radial	x	x			DP-5	
560A-2	12.50	2	Radial	x	x			DP-2	
551A	17.50	2	Radial	x	x			DP-2	Special 2-pole, 2-position switch used to switch any RF device in or out of series connection in a coaxial line. See figure (over).
556	.95	–	–		x			–	Bracket only, for wall mounting of radial connector switches.
590	17.95	5	Axial	x				DP-5	
590G	17.95	5	Axial	x			x	Supplied	Grounds all except selected output circuit.
592	16.50	2	Axial	x				DP-2	
595	18.50	6	In-line		x	x	x		Grounds all except selected output circuit.

Model 375

Model 376

Model 560A-2

TUFTS RADIO CATALOG TUFTS RADIO

There is no substitute for quality, performance, or the satisfaction of owning the very best.

Hence, the incomparable Hy-Gain 3750 Amateur transceiver. The 3750 covers all amateur bands 1.8-30 MHz (160-10 meters). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FET's at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.

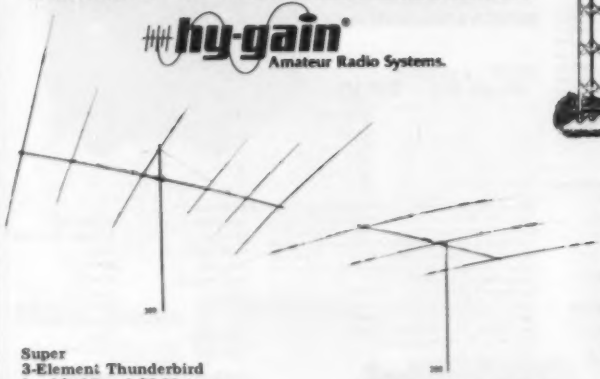
Matching speaker unit (3854) and complete external VFO (3855) also available.

See the incomparable Hy-Gain 3750 at your radio dealer or write Department MM. There is no substitute.

3854 – $69.95 3750 – $1895.00 3855 – $495.00

There is no substitute.

hy-gain Amateur Radio Systems.



Super 3-Element Thunderbird for 10, 15 and 20 Meters Model TH3Mk3 — $199.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

	TH6DXX	TH3Mk3
Electrical		
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 lbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.

6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6 DXX $249.95 Separate HY-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and re-adjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

HY-GAIN'S INCOMPARABLE HY-TOWER FOR 80 THRU 10 METERS

Model 18HT
- **Outstanding Omni-Directional Performance**
- **Automatic Band Switching**
- **Installs on 4 sq. ft. of real estate**
- **Completely Self-Supporting**

By any standard of measurement, the Hy-Tower is unquestionably the finest multi-band vertical antenna system on the market today. Virtually indestructible, the Model 18HT features automatic band selection on 80 thru 10 meters through the use of a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical ¼ wavelength (or odd multiple of a ¼ wavelength) exists on all bands. Fed with 52 ohm coax, it takes maximum legal power ... delivers outstanding performance on all bands. With the addition of a base loading coil, it also delivers outstanding performance on 160 meters. Structurally, the Model 18HT is built to last a lifetime. Rugged hot-dipped galvanized 24 ft. tower requires no guyed supports. Top mast, which extends to a height of 50 Ft., is 6061ST6 tapers aluminum. All hardware is iridite treated to MIL specs. If you're looking for the epitome in vertical antenna systems, you'll want Hy-Tower, Shpg. Wt., 96.7 lbs. Order No. 182, Price: $279.95
NEW Special hinged base assembly on Model 18HT allows complete assembly of antenna at ground level ... permits easy raising and lowering of the antenna.

BROAD BAND DOUBLET BALUN for 10 thru 80 meters Model BN-86 $15.95

The model BN-86 balun provides optimum balance of power to both sides of any doublet and vastly improves the transfer of energy from feedline to antenna. Power capacity is 1 KW DC. Features weatherproof construction and built-in mounting brackets. $15.95 Shpg. Wt. 1 lb. Order No. 242

MULTI-BAND HY-Q TRAP DOUBLETS Hy-Q Traps
- **Install Horizontally or as Inverted V**
- **Super-Strength Aluminum Clad Wire**
- **Weatherproof Center and End Insulators**

Installed horizontally or as an inverted V, Hy-Gain doublets with Hy-Q traps deliver true half wavelength performance on every design frequency. Matched traps, individually pretuned for each band feature large diameter coils that develop an exceptionally favorable L/C ratio and very high Q performance. Mechanically superior solid aluminum trap housings provide maximum protection and support to the loading coil. Fed with 52 ohm coax, Hy-Gain doublets employ super-strength aluminum clad single strand steel wire elements that defy deterioration from salt water and smoke ... will not stretch ... withstand hurricane-like winds. SWR less than 1.5:1 on all bands. Strong, lightweight, weatherproof center insulators are molded from high impact cyolac. Hardware is iridate treated to MIL specs. Heavily serrated 7-inch end insulators molded from high impact cycolac increase leakage path to approximately 12 inches.

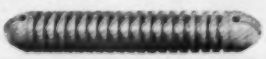
MODEL 2BDQ for 40 and 80 meters. 100' 10½" overall. Takes maximum legal power. Shpg. Wt., 7.5 lbs $49.95 Order No. 380
MODEL 5BDQ for 10, 15, 20, 40 and 80 meters. 94' overall. Takes maximum power. Shpg. Wt., 12.2 lbs. $79.95 Order No. 383

CENTER INSULATOR for Multi-Band Doublets Model CI

Strong lightweight, weatherproof Model CI is molded from high impact cycolac. Hardware is iridite treated to MIL specs. Accepts ¼" or ⅜" coaxial. Shpg. Wt., 0.6 lbs. $5.95 Order No. 155

MULTI-BAND ANTENNA Dipole Antenna — Model DIV-80 $13.95 For 10 thru 80 meters — choice of one band

A dipole antenna for the individuals who prefer the "do-it-yourself" flexibility of custom-designing an antenna for your specific needs. (Work the frequencies you wish in the 10 through 80 meters bands).
The DIV-80 features: Durable Copperweld wire for greater strength, Mosley Dipole Connector (DPC-1) for RG-8/U or RG-58/U coax and all the technical information you will need to construct your custom-designed antenna.



END INSULATORS for Doublets Model EI

Rugged 7-inch end insulators are molded from high impact cycolac that is heavily serrated to increase leakage path to approximately 12 inches. Available in pairs only. Shpg. Wt., 0.4 lbs. $3.95 Order No. 156

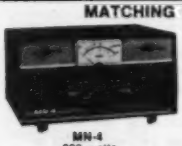
- *Remote*
- *Motor Controlled*

RCS-4

COAX ANTENNA SWITCH

- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. **Price: $120.00**

MATCHING NETWORKS



MN-4
200 watts
Price: $110.00

MN-2000
2000 watts PEP
Price: $220.00

General: ● **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power ● **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 ● Covers ham bands 80 thru 10 meters ● **Switches in or out** with front panel switch ● **Size:** 5½"H, 10¾"W, 8"D (14.0 x 27.3 x 20.3 cm). MN-2000, 14⅛"D (36.5 cm).
● **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) ● **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.

RF WATTMETERS

W-4 **1.8-54 MHz** **Price: $ 72.00**
WV-4 **20-200 MHz** **Price: $ 84.00**

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3⅛"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts	±(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)

DRAKE

SSR-1 COMMUNICATIONS RECEIVER

- **Synthesized • General Coverage**
- **Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands**
- **Excellent Performance**

PRELIMINARY SPECIFICATIONS: • **Coverage:** 500 kHz to 30 MHz • **Frequency** can be read accurately to better than 5 kHz • **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM • **Selectable sidebands** • **Built-in power supply:** 117/234 VAC ± 20% • **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) • **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.
The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.
Price: $350.00

GENERAL: ● **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges ● **Solid State VFO** with 1 kHz dial divisions ● **Modes** SSB Upper and Lower, CW and AM ● **Built-in Sidetone** and automatic T/R switching on CW ● **30 tubes and semi-conductors** ● **Dimensions:** 5½"H, 10¾"W, 14½" D (14.0 x 27.3 x 36.5 cm). **Wt.:** 16 lbs. (7.3 kg).
TRANSMIT: ● **VOX or PTT** on SSB or AM ● **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts ● **Adjustable pi-network.**
RECEIVE: ● **Sensitivity** better than ½ μV for 10 dB S/N ● **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. ● **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression ● **Diode Detector** for AM reception.
Price: $649.00

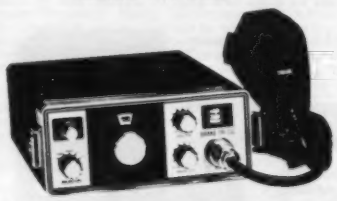
TR-4CW SIDEBAND TRANSCEIVER

34-PNB Plug-in Noise Blanker	100.00
FF-1 Crystal Control Unit	46.95
MMK-3 Mobile Mount	7.00
RV-4C Remote VFO	120.00

POWER SUPPLIES

AC-4 Power Supply	$120.00
DC-4 Power Supply	135.00

2 METER FM PORTABLE TRANSCEIVER
Model TR-33C



Amateur Net $229.95

- SCPC* Frequency Control
- 12 Channels with Selectable Xmtr Offsets.
- All FET Front-end and Crystal Filter for Superb Receiver Intermod Rejection.
- Expanded Antenna Choice.
- Low Receiver Battery Drain.
- Traditional R. L. Drake Service Backup.
- Single Crystal Per Channel.

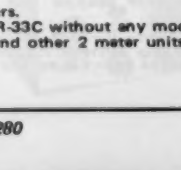
LINEAR AMPLIFIER
Model L-4B

L-4B Linear Amplifier **895.00**
● 2000 Watts PEP-SSB ● Class B Grounded-Grid — two 3-500Z Tubes ● Broad Band Tuned-Input ● RF Negative Feedback ● Transmitting AGC ● Directional Wattmeter ● Two Tautband Suspension Meters ● L-4B 13-15/16" W, 7-7/8" H, 14-5/16" D. Wt.: 32 lbs. ● Power Supply 6-3/4" W, 7-7/8" H, 11" D, Wt.: 43 lbs.

POWER SUPPLIES

AC 4 Power Supply	$120.00
DC 4 Power Supply	135.00

Touch-n-go with DRAKE 1525EM
Push Button Encoding Mike



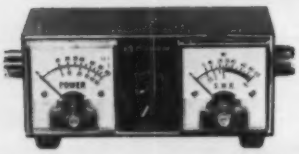
Drake 1525EM, microphone with tone encoder and connector for TR-33C, TR-22, TR-22C, ML-2 ..... **$49.95**

- Microphone and auto-patch encoder in single convenient package with coil cord and connector. Fully wired and ready for use.
- High accuracy IC tone generator, no frequency adjustments.
- High reliability Digitran® keyboard.
- Power for tone encoder obtained from transceiver through microphone cable. No battery required. Low current drain.
- Low output impedance allows use with almost all transceivers.
- Four pin microphone plug: directly connects to Drake TR-33C without any modification in transceiver. Compatible with all previous Drake and other 2 meter units with minor modifications.
- Tone level adjustable.
- Hang-up hook supplied.

TUFTS RADIO CATALOG TUFTS RADIO

why waste watts?

(SWR-1A $25.95)



SWR-1 guards against power loss

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

DELUXE 742 TRI-BAND MOBILE ANTENNA

- Automatically adjusts to proper resonance for 20, 40 and 75 meters.
- Power rated at 500 Watts P.E.P.
- Includes base section, automaticoil and whip top section. 742 Antenna

Price: $109.95

EXCLUSIVE DELUXE 5-BAND MOBILE 45 ANTENNA

- All band manual switching antenna for 10, 15, 20, 40 and 75 meters.
- Power rated at 1000 Watts P.E.P.
- Includes base section with mobilecoil and six foot whip top section. 45 Antenna

Price: $119.95

SWAN METERS HELP YOU GET IT ALL TOGETHER

These wattmeters tell you what's going on.

With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you. Use your Swan credit card. Applications at your dealer or write to us.

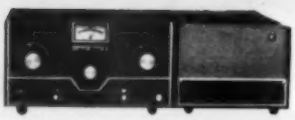
WM2000 In-Line Wattmeter With Muscle. Scales to 2000 watts. New flat response directional coupler for maximum accuracy. $59.95

WM3000 Peak-reading Wattmeter. Reads RMS power then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $79.95

WM1500 High-Accuracy In-Line Wattmeter. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales. 2 to 30 MHz. Forward and reflected power. Use it for trouble-shooting, too! $24.95

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

SWAN LINEAR AMPLIFIERS A Mark II 2000 watt P.E.P. full legal input power unit or the 1200X matching Cygnet 1200 watt P.E.P. input powerhouse with built-in power supply. The choice is yours. **$849.95**



NEW Swan MMBX Impedance Matcher

It keeps your transmitter and your antenna on speaking terms for a song. Price: $23.95

CYGNET 1200X PORTABLE LINEAR AMPLIFIER

To quadruple the output of the 300B Cygnet *de novo*, simply add this matching unit for more than a kilowatt of power. Complete with self-contained power supply and provision for external ALC, this Cygnet offers exceptionally high efficiency and linearity. **$349.95**

Additional Swan products include: fixed and mobile antennas, VFO's telephone patch, VOX, wattmeter, microphones and mounting kits. As another extra service, only Swan Electronics offers factory-backed financing to the amateur radio community. Visit an authorized Swan Electronics dealer for complete details

SWAN® ELECTRONICS

JMR MOBIL-EAR™

Two-way-radio headset with superior fidelity Electret-Capacitor boom microphone and palm-held talk switch.

$69.95

MODEL 1015-A

FOR BROADCAST-QUALITY TRANSMISSION AND RECEPTION FOR BOTH MOBILE UNITS AND BASE STATIONS.

- Boom-mounted electret-capacitor microphone delivers studio-quality, undistorted voice reproduction. Variable gain control lets you adjust for optimum modulation.
- Cushioned earcup lets you monitor in privacy – no speaker blare to disturb others. Blocks out environmental noises, too. Made of unbreakable ABS plastic.
- Headband self-adjusts for comfortable wear over long hours. Spring-flex hinge lets you slip headset on and off with just one hand. Reversible for right or left ear.
- Headset can be hung on standard microphone clip.
- Compact palm-held talk switch lets you keep *both* hands on the wheel for safer driving. Made of unbreakable ABS plastic.
- Built-in FET transistor amplifier adapts microphone output to any transceiver impedance.
- Compatible with most two-way radios including 40-channel CB units.
- Built-in Velcro pad for easy mounting of the talk switch.
- Made in U.S.A.

SPECIFICATIONS

Earphone impedance and type:	8 ohms, dynamic
Microphone type:	Electret capacitor
Microphone frequency response:	200–6000 Hz
Amplifier type:	FET transistor, variable gain
Amplifier battery power:	7-volt Mallory TR-175
Switching:	Relay or electronic

IDEAL FOR EVERY TWO-WAY RADIO COMMUNICATIONS NEED . . .

CB operators • Amateur radio operators • Police and fire vehicles • Ambulances and emergency vehicles • Taxis and truckers • Marine pleasure and work boats • Construction and demolition crews • Industrial communications • Security patrols • Airport tower and ground crews • Remote broadcast and TV-camera crews • Foresters and fire-watch units •

Tufts Radio Electronics • 209 Mystic Avenue • Medford MA 02155 • (617) 395-8280

TUFTS RADIO CATALOG — TUFTS RADIO

ARGONAUT #509

AMPLIFIER #405

TEN-TEC

ARGONAUT, MODEL 509
Covers all Amateur bands 10-80 meters. 9 MHz crystal filter. 2.5 kHz bandwidth. 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction: aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405
Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter. SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509 ..... $359.00
Linear Amplifier, Model 405 . 159.00
Power Supply, Model 251
(Will power both units) 85.00
Power Supply, Model 210
(Will power Argonaut only) .. 30.00

The new ultra-modern fully solid-state TRITON makes operating easier and a lot more fun, without the limitations of vacuum tubes.

For one thing, you can change bands with the flick of a switch and no danger of off-resonance damage. And no deterioration of performance with age.

But that's not all. A superlative 8-pole i-f filter and less than 2% audio distortion, transmitting and receiving, makes it the smoothest and cleanest signal on the air.

The TRITON IV specifications are impeccable. For selectivity, stability and receiver sensitivity. And it has features such as *full* CW break-in, pre-selectable ALC, off-set tuning, separate AC power supply, 12 VDC operation, perfectly shaped CW wave form, built-in SWR bridge and on and on.

For new standards of SSB and CW communication, write for full details or talk it over with your TEN-TEC dealer. We'd like to tell you why "They Don't Make 'Em Like They Used To" makes Ham Radio even more fun.

TRITON IV $699.00

ACCESSORIES:

Model 240 One-Sixty Converter	$ 97.00
Model 244 Digital Readout	197.00
Model 245 CW Filter	$25.00
Model 249 Noise Blanker	29.00
Model 252G Power Supply	109.00
Model 262G Power Supply/VOX	139.00

TEN-TEC

KR20-A ELECTRONIC KEYER
A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. Price $69.50

KR5-A ELECTRONIC KEYER
Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. Price $39.50

KR1-A DELUXE DUAL PADDLE
Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. Price $35.00

KR2-A SINGLE LEVER PADDLE
For keying conventional "TO" or discrete character keyers, as used in the KR20-A. Price $17.00

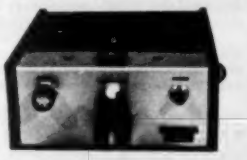
KR50 ELECTRONIC KEYER
A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weithting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortless. The jambie (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing. Price $110.00

SPECIFICATIONS
Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms.
Power Source: 117VAC, 50-60 Hz, 6-14 VDC.
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¼"
Weight: 1¾ lbs.

TEN-TEC



KR50

NORTH SHORE RF TECHNOLOGY

DUPLEXER & CAVITY KITS...

NOW AVAILABLE FOR YOU FULLY ASSEMBLED & TUNED!

- UPGRADE YOUR REPEATER WITH AN RF TECHNOLOGY DUPLEXER.
- ALL DUPLEXERS AND CAVITIES ARE TEMPERATURE COMPENSATED WITH INVAR® AND MEET ALL COMMERCIAL STANDARDS
- ONLY TOP QUALITY MATERIALS GO INTO OUR PRODUCTS.
- BOTH KITS & ASSEMBLED DUPLEXERS AND CAVITIES ARE AVAILABLE TO YOU AT A SAVINGS TO YOU.

Mod. 62-3 . . . 6 cav., 2 mtr., insertion loss 0.6 db with isolation 100 db typical; pwr. 350 w. Kit $399 ea. — Assembled $499.

Mod. 4220-3 . . . 4 cav. 220 MHz insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kit $279 ea. — Assembled $349.

Mod. 4440-3 . . . 4 cav. 440 MHz, insertion loss 0.6 db with 80 db isolation loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kits $249 ea. — Assembled $329.

Mod. 30 Cavity Kits: 2 mtr. $75 ea., 220 MHz $65 ea., 440 MHz $65 ea.; 6 mtr. $115 ea. Add $15 for Assembled Kit.

Also available: 6 mtr., 4 cav. Kit $399 — Assembled $499, 2 mtr. 4 cav. Kit $299 — Assembled $399, 440 MHz TV Repeater Duplexer.

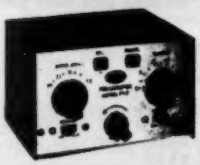
Now You Can Receive The Weak Signals With The ALL NEW AMECO PREAMPLIFIER

Model PT-2 is a continuous tuning 6-160 meter Pre-Amp specifically designed for use with a transceiver. The PT-2 combines the features of the well-known PT with new sophisticated control circuitry that permits it to be added to virtually any transceiver with No modification. No serious ham can be without one.

- Improves sensitivity and signal-to-noise ratio.
- Boosts signals up to 26 db.
- For AM or SSB.
- Bypasses itself automatically when the transceiver is transmitting.
- FET amplifier gives superior cross modulation protection.
- Advanced solid-state circuitry.
- Simple to install.
- Improves immunity to transceiver front-end overload by use of its built-in attenuator.
- Provides master power control for station equipment.

MODEL PT-2

$69.95



Tufts Radio Electronics ● 209 Mystic Avenue ● Medford MA 02155 ● (617) 395-8280

TUFTS RADIO CATALOG — TUFTS RADIO

BIRD

The indispensable BIRD model 43 THRULINE® Wattmeter

Read RF Watts Directly.

0.45-2300 MHz, 1-10,000 watts ±5%, Low Insertion VSWR—1.05.

Unequalled economy and flexibility: Buy only the element(s) covering your present frequency and power needs, add extra ranges later if your requirements expand.

Table 1
STANDARD ELEMENTS (CATALOG NUMBERS)

Power Range	Frequency Bands (MHz) 2-30	25-60	100-250	200-500	400-1000
5 watts	—	5A	5C	5D	5E
10 watts	—	10A	10C	10D	10E
25 watts	—	25A	25C	25D	25E
50 watts	50H	50A	50C	50D	50E
100 watts	100H	100A	100C	100D	100E
250 watts	250H	250A	250C	250D	250E
500 watts	500H	500A	500C	500D	500E
1000 watts	1000H	1000A	1000C	1000D	1000E
2500 watts	2500H				
5000 watts	5000H				

MODEL	PRICE
43	$120
Elements (Table 1) 2-30 MHz	42
Elements (Table 1) 25-1000 MHz	36
Carrying case for Model 43 & 6 elements	26
Carrying case for 12 elements	16

(Specify Type N or SO239 connectors)

BOMAR Crystal Company

Novice Crystals (Specify Band Only)

TWO METERS

CRYSTALS IN STOCK

Motorola HT 220 Crystals In Stock!

Standard ● Icom ● Heathkit ● Ken ● Clegg ● Regency ● Wilson ● VHF Eng ● Drake ● And Others!

$4.50 @ Lifetime Guarantee

Make/Model	Xmit Freq.	Rec. Freq.

THE BIG SIGNAL "W2AU" BALUN $12.95

THE APPROVED LEADING HAM AND COMMERCIAL BALUN IN THE WORLD TODAY.

THE PROVEN BALUN

1. HANDLES FULL 2 KW PEP AND THEN SOME. Broad-Banded 3 to 40 MC.
2. HELPS TVI PROBLEMS By Reducing Coax Line Radiation
3. HOW ALL STAINLESS STEEL HARDWARE. SO239 Double Silver Plated
4. IMPROVES F/B RATIO By Reducing Coax Line Pick-Up
5. REPLACES CENTER INSULATOR. Withstands Antenna Pull of Over 600 Lbs.
6. BUILT-IN LIGHTNING ARRESTER. Helps Protect Balun — Could Also Save Your Valuable Gear
7. BUILT-IN HANG-UP HOOK. Ideal For Inverted Vees, Multi-Band Antennas, Dipoles, Beam and Quads

NOW BEING USED BY ALL BRANCHES OF THE U.S. ARMED FORCES, FAA, RCA, CIA, CANADIAN DEFENCE DEPT. PLUS THOUSANDS OF HAMS THE WORLD OVER

THEY'RE BUILT TO LAST...

BIG SIGNALS DON'T JUST HAPPEN— GIVE YOUR ANTENNA A BREAK

Comes in 2 models. 1:1 matches 50 or 75 ohm unbalanced coax line to 50 or 75 ohm balanced load. 4:1 model matches 50 or 75 ohm unbalanced coax line to 200 or 300 ohm balanced load.

AVAILABLE AT ALL LEADING DEALERS. IF NOT, ORDER DIRECT

The big signal W2AU Balun reflects the type of quality that has kept our product out front and number 1 in Baluns the world over for the past 10 years.

The originator of the Balun with a built-in lightning arrestor and hang up hook.

We'll GUARANTEE no other balun, or any price, has all these features.

SERIES 31 — BNC CONNECTORS

Amphenol's BNC connectors are small, lightweight, weatherproof connectors with bayonet action for quick disconnect applications.

Shells, coupling rings and male contacts are accurately machined from brass. Springs are made of beryllium copper. All parts in turn are ASTROplated® to give you connectors that can take constant handling, high temperatures and resist abrasion.

UG-273

UG-1094

575-102-385

BNC BULKHEAD RECEPTACLE 31-221-385 UG-1094 Mates with any BNC plug. Receptacle can be mounted into panels up to 104" thick. $1.25

BNC (M) TO UHF (F) ADAPTER 309-2900-385 UG 255 Adapts any BNC jack to any UHF plug. $3.63

DOUBLE MATE ADAPTER 83-877-385 Both coupling rings are free turning. Connects 2 female components. $2.72

JACK ADPATER $1.95

575-102-385 Adapts 83-1SP-385 to Motorola type auto antenna jack or pin jack.

PANEL RECEPTACLE 83-1R-385 SO239 Mounts with 4 fasteners in 21/32" diameter hole. $1.17

PANEL RECEPTACLE 83-878-385 SO239SH Mounts in single 21/32" diameter hole. Knurled lock nuts prevent turning. $1.59

BNC ANGLE ADAPTER 31-009-385 UG-306 Adapts any BNC plug for right angle use. $4.23

BNC TEE ADAPTER 31-008-385 UG-274 Adapts 2 BNC plugs to 31-003-385 or other female BNC type receptable. $4.56

BNC(F) TO UHF (M) ADAPTER 31-028-385 UG-273 Adapts any BNC plug to any UHF jack. $2.39

PUSH-ON 83-1SP-385 83-5SP-385 Features an unthreaded, springy shell to push fit on female connectors. $2.27

LIGHTNING ARRESTOR 575-105-385 Eliminates static build-up from antenna. Protects your valuable equipment against lightning damage. $4.80

BNC PLUG 31-002-385 UG-88 Commonly used for communications antenna lead cables. For RG 55/U & RG 58/U cables. $1.59

BNC STRAIGHT ADAPTER 31-219-385 UG-914 1 9/32" long, allows length of cables to be joined. Mates with BNC plugs. $2.12

BNC PANEL RECEPTACLE 31-003-385 UG-290 Mounts with 4 fasteners in 29/64" diameter hole. $1.74

SERIES 581 — PACKAGED CABLE ASSEMBLIES

All popular lengths are now available in your choice of RG 8/U or RG 58/U type low loss polyfoam dielectric cable. Installed PL-259 connectors are ASTROplated — Amphenol's new non-tarnishing finish — which has all the advantages of precious metal plus more heat, corrosion and abrasion resistors that silver ever had! These cable assemblies are ideal for CB, ham radio and other communications antenna installations and they are ready for immediate use.

83-877-385

SO239

PL-259 ... 90¢
UG-175 (Adapter for RG 58U) ... 25¢

UG-290

UG-274

SO239SH

83-5SP-385

UG-306

575-105-385

UG-255

UG-88

UG-914

RG 8/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES 581-803 3-ft. with ASTROplated PL-259's on both ends. $5.60

581-820 20-ft with ASTROplated PL-259's on both ends. $11.80

581-850 50-ft with ASTROplated PL-259's on both ends. $23.10

581-875 75-ft with ASTROplated PL-259's on both ends. $30.30

581-8100 100-ft. with ASTROplated PL-259's on both ends. $38.50

RG 58/U TYPE POLYFOAM COAXIAL CABLE ASSEMBLIES 581-5812 12-ft. with ASTROplated PL-259's on both ends. $6.34

581-5820 20-ft with ASTROplated PL-259's on one end and SPADE LUGS ON OTHER END. $6.30

518-5820-2 20-ft. with ASTROplated PL-259's on both ends. $7.36

581-5850 50-ft. with ASTROplated PL-259's on both ends. $11.20

581-5875 75-ft. with ASTROplated PL-259's on both ends. $14.00

581-58100 100-ft. with ASTROplated PL-259's on both ends. $16.10

A new precision clock which tells time anywhere in the world at a glance, has been announced by **Yaesu Electronics Corporation**. The time in any principal city or time zone can be simultaneously coordinated with local time on a 24 hour basis. After the initial setting, as the clock runs, a Time Zone Hour Disc advances automatically, showing correct time all over the world without further adjustment. The clock is especially designed to withstand shock and may be hung on a wall or placed on its desk mount. The clock will run an entire year on a single 1.5 volt flashlight battery and the mechanism starts as soon as the battery is inserted. It measures six inches in diameter by two and one half inches deep. An excellent item for the business office, ham radio operator, short wave listener, boat owner, and others who want an accurate dependable clock.

Price: $30.00 Amateur net.

Educator II
& Power Supply Kits

KEY FEATURES

- On-board clock.
- 128 x 8 RAM.
- On-board provision for second 128 x 8 RAM.
- Resident executive provides for front panel control.
- Built-in cassette interface for program load and record.
- Search feature for program load from cassette provided.
- Edge connectors provide full interface to peripheral interface adapter (PIA) and all address, data and control bus signals for system expansion.
- Test-As-You-Build for accurate, error-free construction.
- Easy, quick construction — one evening.
- Support documentation aimed at teaching MPU theory and programming.
- Completely self-contained. All parts included as well as complete construction manual.
- Separate power supply required 5V @ 1.0 amps.

KEY FEATURES

- Designed specifically for the Educator II.
- Regulated 5.0 - 5% volts d.c. output @ 1.0 amps.
- 60 Hz real time clock available (approximately 5.1V peak-to-peak.)
- Complete kit — all parts, cabinet and construction manual.
- Easy, one evening construction.

CUSTOMER INFORMATION

- **EDUCATOR II KIT PRICING INFORMATION:** Suggested Resale: $169.95
- **ACCESSORIES:** POWER SUPPLY (SEE PHOTO ABOVE): Suggested Resale: $29.95 ADDITIONAL 128 x 8 RAM (C4811): Suggested Resale: $19.94
- **ACCESSORIES TO COME IN NEAR FUTURE:** VIDEO DISPLAY, KEYBOARD, MODULE CARD RACK AND POWER SUPPLY, MEMORY MODULES, APPLICATIONS PROGRAMS ON CASSETTES

● SELECTIVITY CONTROL
This amazing new breakthrough in filter design is truly the filter of the future. Selectivity control on the front panel provides control of bandwidth as well as selection of upper or lower sideband, or double sideband. Continuously variable from 300 to 2700 Hz bandwidth. Shape factor is better than 1.7, with ultimate rejection better than 130 dB. Selectivity for SSB can be set for maximum voice fidelity at 2700 Hz bandwidth, providing transmission and reception of audio from 300 to 3000 Hz, or it can be narrowed down to 2400, 2100 or even 1500 Hz if necessary to reduce adjacent channel QRM. Selectivity can be narrowed gradually to as little as 300 Hz for CW reception.

This amazing new breakthrough in filter design is by Bob Crawford and Eckert Argo of Consulting Engineers. Atlas Radio is privileged to be first to offer this "programmable filter" in the radio communication field and for sometime to come will be the only one.

● RECEIVER INCREMENTAL TUNING
● AUDIO FREQUENCY NOTCH FILTER
● PUSH TO TALK
● VOX OPERATION
● FULL BREAK-IN CW OPERATION
MODEL 350-XL $995

● DIGITAL DIAL READOUT
The Atlas 350-XL has space provided for quick installation of this plug-in accessory. Provides precise frequency readout within 50 Hz. All L.E.D. Dot Matrix 6 digit display.
DD6-XL DIGITAL DIAL $195

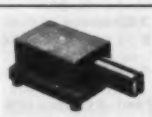
● PLUG-IN AUXILIARY VFO or CRYSTAL OSCILLATOR
Auxiliary VFO is plugged into the space provided on the front panel of the 350-XL. You have a second tuneable VFO with same tuning ranges as primary VFO for tuning to a separate transmit or receive frequency. LEDs indicate which VFO, primary or secondary, will be used for receive and transmit.

Or instead of the auxiliary VFO a Crystal Oscillator may be plugged into the front panel. Eleven crystal sockets are available with a vernier control for exact frequency setting.
MODEL 305 AUXILIARY VFO $155
MODEL 311 AUXILIARY CRYSTAL OSCILLATOR $135

● 350-PS MATCHING AC SUPPLY
Includes front facing speaker and phone jack. Provides 14 volts filtered and regulated D.C. for both low current and high current circuits of the 250-XL. Internal space provided for future installation of accessories such as CW Keyer, Speech Processor, Phone Patch, etc. Operates on 100-130 or 200-260 volts, 50-60 Hz ..$195

● SAME PLUG-IN-AND-GO MOBILE FEATURE AS OUR FAMOUS 210x/215x
The 350-XL has its own optional Mobile Mounting Bracket for quick, easy plug-in or removal from your car. All connections are made automatically $65

● ATLAS 210x/215x SSB TRANSCEIVERS
Our famous little compact SSB Transceivers remain a very important part of our product line $679
With noise blanker installed $719



NYE VIKING SQUEEZE KEY
Extra-long, finger-fitting molded paddles with adjustable spring tension, adjustable contact spacing. Knife-edge bearings and extra large, gold plated silver contacts! Nickel plated brass hardware and heavy, die cast base with non-skid feet. Base and dust cover black crackle finished. SSK-1 — $23.45.
SSK-1CP has heavily chrome-plated base and dust cover. List price, $29.95.

NYE VIKING SPEED-X KEYS
NYE VIKING Standard Speed-X keys feature smooth, adjustable bearings, heavy-duty silver contacts, and are mounted on a heavy oval die cast base with black wrinkle finish. Available with standard, or Navy knob, with, or without switch, and with nickel or brass plated key arm and hardware.

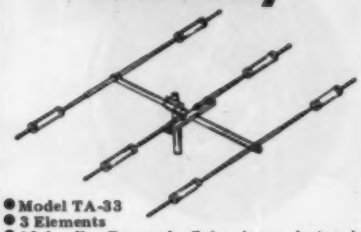
Pamper yourself with a Gold-Plated NYE VIKING KEY!
Model No. 114-31C-004GP has all the smooth action features of NYE Speed-X keys in a special "presentation" model. All hardware is heavily gold plated and it is mounted on onyx-like jet black plastic sub-base. List price is $50.00.

CODE PRACTICE SET You get a sure, smooth, Speed-X model 310-001 transmitting key, linear circuit oscillator and amplifier, with a built-in 2" speaker, all mounted on a heavy duty aluminum base with non-skid feet. Operates on standard 9V transistor type battery (not included). List price, $18.50.
PHONE PATCH Model No. 250-46-1 measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $36.50. Model 250-46-3, designed for use with transceivers having a built-in speaker, has its own built-in 2" x 6" 2 watt speaker. Measures 6-1/2" wide, 2-1/4" high and 2-7/8" deep. List price, $44.50.

Tufts Radio Electronics ● 209 Mystic Avenue ● Medford MA 02155 ● (617) 395-8280

TUFTS RADIO CATALOG TUFTS RADIO

Mosley



- Model TA-33
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

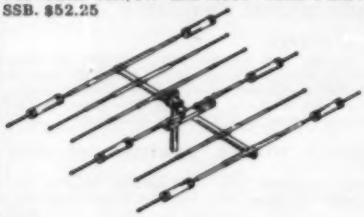
The Mosley TA-33, 3-element beam provides outstanding 10, 15 and 20 meter performance. Exceptionally broadband — gives excellent results over full Ham bandwidth. Incorporating Mosley Famous Trap-Master traps. Power Rating — 2KW P.E.P. SSB. The TA-33 may also be used on 40 meters with TA-40KR conversion. Complete with hardware. $206.50

MULTI-BAND BEAMS
TRAP MASTER 33 . . . 10, 15 & 20 Meters

- Model TA-33Jr.
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

The TA-33Jr . . . incorporates Mosley Trap-Master Junior traps. This is the low power brother of the TA-33. Power Rating — 1 KW P.E.P. SSB. $151.85

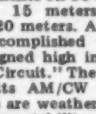
TA-33JR. POWER CONVERSION KIT MODEL MPK-3
Owners of the Mosley Trap-Master TA-33Jr. may obtain higher power without buying an entirely new antenna. The addition of the MPK-3 (power conversion kit) converts the TA-33Jr. into essentially a new antenna with 750 watts AM/CW and 2000 watts P.E.P. SSB. $52.25



TRAP MASTER 36 . . . 10, 15 & 20 Meters

- Model TA-36
- 6 Elements
- Forward Gain (over isotropic source) - 10.1 db on 15 & 20 meters, 11.1 db on 10 meters.

Front-to-Back Ratio on all bands. 20 db.
This wide-spaced, six element configuration employs 4 operating elements on 10 meters, 3 operating elements on 15 meters, and 3 operating elements on 20 meters. Automatic bandswitching is accomplished through Mosley exclusively designed high impedance parallel resonant "Trap Circuit." The TA-36 is designed for 1000 watts AM/CW or 2000 watts P.E.P. SSB. Traps are weather and dirt proof, offering frequency stability under all weather conditions. $335.25

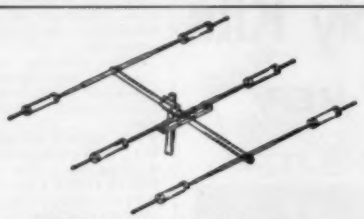


MOSLEY AK-60 MAST PLATE ADAPTER
Mast Plate Adapter for adapting your Mosley 1½" mounted beam to fit 2" OD mast. Complete with angle and hardware. $11.15

NATIONAL RADIO COMPANY, INC.
NRCI

NCL-2000
Linear Amplifier. A full 10 Db gain. 20 watts in 2000 watts out. Can be driven with one watt. Continuous duty design utilizes two 8122 ceramic tetrode output tubes, designed for both AM and SSB operation. The industry standard for 12 years. Thousands in use all over the world. Price: $1,200

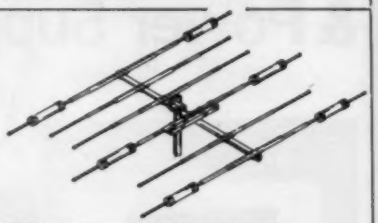
NCX-1000
The only 1000 watt, "single package" transceiver. Heavy duty design . . . results of 50 years of design leadership in amateur equipment. State of the art speech processing, linear amplifier, power supply, all in one package. Nothing extra to buy. Covers all amateur bands in HF spectrum . . . AM, SSB, CW. Price: $1,600



CLASSIC-33 . . . 10, 15 & 20 Meters
Model CL-33

- 3 Elements
- 10.1 db Forward Gain (over isotropic source) on all bands.
- 20 db Front-to-Back Ratio on 15 & 20 meters, 15 db on 10 meters.

BRIDGING THE GAP . . . The Classic 33, combines the best of two Mosley systems. Incorporating Mosley Classic Feed System for a "Balanced Capacitive Matching" system with a feed point impedance of 52 ohms at resonance, and the Famous Mosley Trap-Master Traps for "weather-proof" traps with resonant frequency stability. This extra sturdy multi-band beam, Model CL-33, for operation on 10, 15 & 20 meters features improved boom to element clamping, stainless steel hardware, balanced radiation and a longer boom for even wider element spacing. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Wind Load — 120 lbs. at 80 MPH. Approx. shipping weight — 45 lbs. $232.50



CLASSIC-36 . . . 10, 15 & 20 Meters
Model CL-36

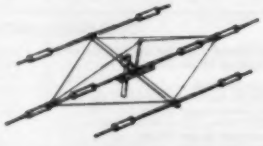
- 6 Elements
- 10.1 db Forward Gain (over isotropic source) on 15 & 20 meters, 11.1 db on 10 meters.
- 20 db Front-to-Back Ratio on all bands.

The Classic 36, like the smaller Classic 33, incorporates both the Mosley World-Famous Trap-Master Traps and the Mosley Classic Feed-System. Designed to operate on 10, 15 & 20 meters, this multi-band beam Model CL-36, employs the high standards of quality construction found in all Mosley products. The boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" system has a feed point impedance of 52 ohms at resonance. Wind Load — 210.1 lbs. at 80 MPH. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Approx. shipping weight — 71 lbs. via truck. $310.65

CLASSIC-203 . . . 20 Meters
Model CL-203
3 Elements

- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

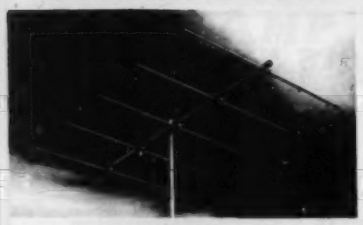
Incorporating the Mosley patented Classic Feed System, this full size 20 meter single-band beam has 1½" to 3/8" dia. "swaged" elements wide spaced on a 2" dia. 24' boom. Maximum element length-37' 8½". The high standards in quality construction established by Mosley in over a quarter-century of manufacturing is reflected in this mono-band . . . Model CL-203. Boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" System has a nominal feed point impedance of 52 Ohms at 2 KW P.E.P. SSB. Recommended mast size-2" O.D. Approx. shipping wt: 42 lbs. via truck. $227.65



40 METER CONVERSION KIT MODEL TA-40KR
Work 40 meters in addition to 10, 15 & 20 meters by using a TA-40KR conversion kit on the radiator element of the TA-33 and TA-36. (Beams with broad band capacitive matching may not be converted!) Convert the TA-33Jr. with the MPK-3 (power conversion kit) before adding the TA-40KR kit. $92.25

SIGNAL-MASTER ANTENNA
Beam Antenna . . . Model S-402 for 40 meters
For a top signal needed to push through forty meter QRM, the Mosley Signal Master S-402 will do the trick! This 100% rust-proof 2-element beauty constructed of rugged heavy-wall aluminum is designed and engineered to provide the performance you need for both DX hunting and relaxing in a QRM free rag-chewing session. Beam is fed through link coupling, resulting in an excellent match over the entire bandwidth. $267.50

6 METER BEAMS



3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Lngth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

new

RINGO RANGER for FM

4.5 dB* — 6 dB**

Omnidirectional GAIN BASE STATION ANTENNAS

FOR MAXIMUM PERFORMANCE AND VALUE

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 2.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install. 6 meter partly preassembled, all but 450 MHz take 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-225	AR-450
Frequency MHz	135-175	135-175	50-54	220-235	440-460
Power—Mdlg. Watts	100	200	100	100	250
Wind area sq. ft.	.21'	.21'	.21'	.20'	.10'

5-4 POLE Up to 8 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 33' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL-259 connector. Package includes 4 complete dipole assemblies on mounting boome, harness and all hardware. Vertical support mast not supplied.

A5M-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
A5M-24D 220 - 225 MHz, 1000 watts, wind area 1.85 sq. ft.
A5M-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK.	complete 4 element stacking kit
A14-SK.	4 element coax harness only
A147-VPK.	complete 11 element stacking kit
A147-SK.	11 element coax harness only
A449-SK.	6 + 11 element coax harness only

E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom./Longest ele.	144"/40"	44"/40"	80"/13"	26"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/26	9/20	13.2/26	11/26	13.2/26
½ Power beam	45°	86°	45°	60°	45°
Wind area sq. ft.	1.21	.63	.20	.30	.50
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 130", weight 10 lbs., longest element 60", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

HIGH PERFORMANCE VHF YAGIS

3/4, 1-1/4, 2 METER BEAMS

The standard of comparison in amateur VHF/UHF communications Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O. D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O. D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144-7	A144-11	A220-11	A430-11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ ½ pwr. pt.	46	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

VHF/UHF BEAMS

A50-3	$ 32.95	A144-7	21.95
A50-5	49.95	A144-11	32.95
A50-6	69.95	A430-11	24.95
A50-10	99.95		

AMATEUR FM ANTENNAS

A147-4	$ 19.95	AFM-44D	54.95
A147-11	29.95	AR-2	21.95
A147-20T	54.95	AR-6	32.95
A147-22	84.95	AR-25	29.95
A220-7	21.95	AR-220	21.95
A220-11	27.95	AR-450	21.95
A449-6	21.95	ARX-2	32.95
A449-11	27.95	ARX-2K	13.95
AFM-4D	59.95	ARX-220	32.95
AFM-24D	57.95	ARX-450	32.95

Description:	144 MHz. Model:	Price:	220 MHz. Model:	Price:	432 MHz. Model:	Price:
20 Element DX-Array Frame & Harness (40 E.)	DX-120	42.95	DX-220	37.95	DX-420	32.95
	DXX-140	69.95	DXX-240	54.95	DXX-440	39.95
Frame & Harness (80 El.)	DXX-180	108.95	DXX-280	89.95	DXX-480	79.95
1-1 52-ohm balun	DX-18N	12.95	DX-28N	13.95	DX-48N	12.95
Vert. Pol. Bracket (20 El.)	DX-VPB	9.95	DX-VPB	9.95	DX-VPB	9.95

TUFTS RADIO CATALOG TUFTS RADIO

TUFTS RADIO CATALOG - TUFTS RADIO

For all you hams with little cars ...

We've got the perfect mobile rig for you.

The Atlas 210x or 215x measures only 9¼" wide x 9½" deep x only 3¼" high, yet the above photograph shows how easily the Atlas transceiver fits into a compact car. And there's plenty of room to spare for VHF gear and other accessory equipment. With the exclusive Atlas plug-in design, you can slip your Atlas in and out of your car in a matter of seconds. All connections are made automatically.

BUT DON'T LET THE SMALL SIZE FOOL YOU!
Even though the Atlas 210x and 215x transceivers are less than half the size and weight of other HF transceivers, The Atlas is truly a giant in performance.

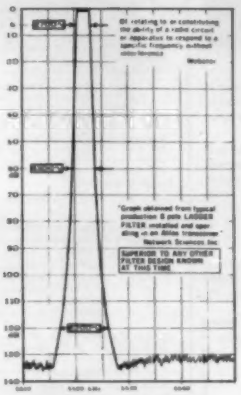
200 WATTS POWER RATING!
This power level in a seven pound transceiver is incredible but true. Atlas transceivers give you all the talk power you need to work the world barefoot. Signal reports constantly reflect great surprise at the signal strength in relation to the power rating.

FULL 5 BAND COVERAGE
The 210x covers 10-80 meters, while the 215x covers 15-160 meters. Adding the Atlas Model 10x Crystal Oscillator provides greatly increased frequency coverage for MARS and network operation.

NO TRANSMITTER TUNING OR LOADING CONTROLS
with Atlas' total broadbanding. With your Atlas you get instant QSY and band change.

MOST ADVANCED STATE OF THE ART SOLID STATE DESIGN
not only accounts for its light weight, but assures you years of top performance and trouble free operating pleasure.

PLUG-IN CIRCUIT BOARDS
and modular design provides for ease of servicing.


"Graph obtained from typical production 8 pole LADDER FILTER installed and operating in an Atlas transceiver"
Network Sciences Inc.
SUPERIOR TO ANY OTHER FILTER KNOWN AT THIS TIME

PHENOMENAL SELECTIVITY
The exclusive 8 pole crystal ladder filter used in Atlas transceivers represents a major breakthrough in filter design, with unprecedented skirt selectivity and ultimate rejection. As the above graph shows, this filter provides a 6 db bandwidth of 2700 Hertz, 60 db down of only 4300 Hertz, and a bandwidth of only 9200 Hertz at 120 db down! Ultimate rejection is in excess of 130 db; greater than the measuring limits of most test equipment.

EXCEPTIONAL IMMUNITY TO STRONG SIGNAL OVERLOAD AND CROSS MODULATION. The exclusive front end design in the receiver allows you to operate closer in frequency to strong neighboring signals than you have ever experienced before. If you have not yet operated an Atlas transceiver in a crowded band and compared it with any other receiver or transceiver, you have a real thrill coming.

A WORLD WIDE DEALER NETWORK TO SERVE YOU.
Whether you're driving a Honda in Kansas City or a Mercedes Benz in West Germany, there's an Atlas dealer near you.

ACCESSORIES	
Atlas 210x or 215x	$675.00
W/Noise Blanker	719.00
AC Console 110/220 V	$147.00
Portable AC supply 110/220 V	100.00
Plug-in Mobile Kit	48.00
10x Osc. less crystals	59.00
Digital Dial DD-6B	239.00

For complete details see your Atlas dealer, or drop us a card and we'll mail you a brochure with dealer list.

ATLAS RADIO INC.

mounts - leads - accessories

STANDARD GAIN MOBILES
Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL SBLT-144
47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $33.75

MODEL SBL-144
47" antenna mounts on any flat surface, roof, deck or fender in ⅜" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount.
Price: $31.95

HUSTLER "BUCK-BUSTER"

MODEL BF-2
51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with ⅜"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included).
Price: $9.00

DELUXE MOBILE MOUNTS
For medium length, light weight antennas with ⅜"-24 base.

MODEL TLM
Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached.
Price: $14.85

MODEL HLM
Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. **Price: $17.20**

MODEL GCM-1
Rain gutter mount fits all shapes, angles even lobed trim line gutters. Includes 180° swivel ball. **Price: $6.00**

MODEL MM-1
Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors.
Price: $7.50

MODEL TGM-1
Trunk groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. **Price: $8.00**

SUPER GAIN MOBILES
Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

TWO AND SIX METERS— TRUNK LIP MOUNT
MODEL HFT
Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 48". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259.
Price: $22.55

VHF/UHF ANTENNAS— ROOF MOUNT
MODEL UNT-1
Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in ⅜" hole. Includes 15' RG-58-U.
Price: $9.95

RESONATOR SPRING— STAINLESS STEEL
MODEL RSS-2
Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging objects. Tuning supplied ready for easy installation. **$ 5.45**

MODEL CGT-144
Get big signal performance, superior receiving capability with this 64" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259.
Price: $41.30

MODEL CG-144
Same characteristics as CGT-144 supplied with ⅜"-24 base to fit all mobile ball mounts — Length is 65". Mount and cable not included. **Price: $25.50**

VHF/UHF ANTENNA— TRUNK LIP MOUNT
MODEL TNF
Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. **Price: $16.55**

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE
MODEL SBM-1
Heavy 5" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cyclelac base, steel back-up plate and mounting hardware.
Price: $10.20

QUICK DISCONNECT— 100% STAINLESS STEEL
MODEL QD-1
Removes antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. ⅜"-24 threads—female one end, male the other.
Price: $10.95

FEED LINE MODEL L-58-240
Get proven performance, maximum shielding for minimum noise pick-up on this MIL SPEC 50 ohm coax. Supplied with connectors at each end for use with ball or bumper mount and transceiver.
Price: $6.55

MODEL QG-144A — Deluxe, two-meter Colinear for Repeater or any fixed station operation. 6 db gain over a ¼ wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator ⅝ wave lower section, ¼ wave phasing, ⅝ wave upper section Height: 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1½" O.D. SO-239 coax connector
Price: $67.55

All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD HUSTLER RESONATORS
Power Rating: 400 Watts SSB

Model	Band	Price
RM-10	10 meters	$ 6.50
RM-15	15 meters	6.95
RM-20	20 meters	7.30
RM-40	40 meters	13.20
RM-75	75 meters	15.50
RM-80	80 meters	15.95

SUPER HUSTLER RESONATORS
Power Rating: Legal Limit SSB
Supers have widest bandwidth

Model	Band	Price
RM-10S	10 meters	$11.30
RM-15S	15 meters	12.65
RM-20S	20 meters	13.00
RM-40S	40 meters	15.50
RM-75S	75 meters	30.00
RM-80S	80 meters	30.40

For 6-10-15-20-40-75-80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 56" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has ⅜"-24 threads to fit mobile ball mount or bumper mount.

HUSTLER MASTS
The Majority Choice of Amateurs Throughout the World!

MODEL MB-2
For bumper mounting—Fold in at roof line 27" above base. **Price: $22.00**

MODEL MB-1
For deck or fender mounting—Fold in at roof line 15" above base. **Price: $22.00**

Covers 10 - 15 - 20 - 40 Meters
Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-STV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers "Spritz" extruded to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss — high strength insulators. Mounting hardware included.
- All sections ⅛" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 9"
MODEL 4-STV
Weight: 15 lbs.
Price: $99.95

SUPER AMP from DenTron

If the amplifier you're thinking of buying doesn't deliver at least 1000 to 1200 watts output, to the antenna, you're buying the wrong amplifier.

Our New Super Amp is sweeping the country because hams have realized that the DenTron Amplifier will deliver to the antenna, (output power), what other manufacturers rate as input power.

The Super Amp runs a full 2000 watts P.E.P. input on SSB, and 1000 watts DC on CW, RTTY or SSTV 160-10 meters, the maximum legal power.

The Super Amp is compact, low profile, has a solid one-piece cabinet assuring maximum TVI shielding.

The heart of our amplifier, the power supply, is a continuous duty, self-contained supply built for contest performance.

We mounted the 4-572B's, industrial workhorse tubes, in a cooling chamber featuring the on-demand variable cooling system.

The hams at DenTron pride themselves on quality work, and we fight to keep prices down. That's why the dynamic DenTron Linear Amplifier beats them all

$574.50

The 80-10 Skymatcher

Here's an antenna tuner for 80 through 10 meters, handles 500 w P.E.P. and matches your 52 ohm transceiver to a random wire antenna.

- Continuous tuning 3.2 - 30 mc
- "L" network
- Ceramic 12 position rotary switch
- SO—239 receptional to transmitter
- Random wire tuner
- 3000 volt capacitor spacing
- Tapped inductor
- Ceramic antenna feed thru
- 7" W. 5" H. 8" D., Weight: 6 lbs.

$59.50

Read forward and reflected watts at the same time

Tired of constant switching and guesswork?

Every serious ham knows he must read both forward and reverse wattage simultaneously for that perfect match. So upgrade with the DenTron W-2 Dual in line Wattmeter.

$99.50

Match everything from 160 to 10 with the new 160-10 MAT

NEW: The Monitor Tuner was designed because of overwhelming demand. Hams told us they wanted a 3 kilowatt tuner with a built-in wattmeter, a front panel antenna selector for coax, balanced line and random wire. So we engineered the 160-10m Monitor Tuner. It's a lifetime investment at $299.50.

$299.50

Meet the SuperTuner

The DenTron Super Tuner tunes everything from 160-10 meters. Whether you have balanced line, coax cable, random or long wire, the Super Tuner will match the antenna impedance to your transmitter. All DenTron tuners give you maximum power transfer from your transmitter to your antenna, and isn't that where it really counts?

1 KW MODEL **$129.50** 3 KW MODEL **$229.50**

The Sky Openers

SKYMASTER

A fully developed and tested 27 foot vertical antenna covers entire 10, 15, 20, and 40 meter bands using only one discretly applied wave trap. A full 1/4 wave antenna on 20 meters. Constructed of heavy seamless aluminum with a factory tuned and sealed HQ Trap, SKYMASTER is weatherproof and withstands winds up to 80 mph. Handles 2 KW power level and is for ground, roof or tower mounting. Radials included in our low price of

$84.50

Also 80 m resonator for top mounting on SKYMASTER.

$29.50

SKYCLAW

A tunable monoband high performance vertical antenna, designed for 40, 80, 160 meter operation. SKYCLAW gives you the following spectrum coverage:

BAND (Meters)	BANDWIDTH (kHz)
160	50
80	200
40	entire band

Tuning is easy and reliable. Rugged construction assures that this self-supporting unit is weatherproof and survives nicely in 100 mph winds.. Handles full legal power limit.

$79.50

EX-1

The DenTron EX-1 Vertical Antenna is designed for the performance minded antenna experimenter. The EX-1 is a full 40 meter, ¼ wave, 33', self-supporting vertical. The EX-1 is the ideal vertical for phasing.

$59.50

TRIM-TENNA

The antenna your neighbors will love. The new DenTron Trim-Tenna with 20 meter beam is designed for the discriminating amateur who wants fantastic performance in an environmentally appealing beam. It's really loaded! Up front there's a 13 foot 6 inch director with precision Hy-Q coils. And, 7 foot behind is a 16 foot driven element fed directly with 52 ohm coax. The Trim-Tenna mounts easily and what a difference in on-the-air performance between the Trim-Tenna and that dipole, long wire or inverted Vee you've been using. 4 & 6 Forward Gain Over Dipole.

$129.50

ALL BAND DOUBLET

This All Band Doublet or inverted Type Antenna covers 160 thru 10 meters. Has total length of 130 feet (14 ga. stranded copper) although it may be made shorter if necessary. This tuned Doublet is center fed through 100 feet of 450 ohm PVC covered balanced transmission line. The assembly is complete. Add rope to the ends and pull up into position. Tune with the DenTron Super Tuner and you're on 10 through 160 meters with one antenna! Now just for the DenTron All Band Doublet.

$24.50

DenTron

DRAKE TVI FILTERS High Pass Filters for TV Sets
provide more than 40 dB attenuation at 52 MHz and lower. Protect the TV set from amateur transmitters 6-160 meters.

Drake TV-300-HP
Model No. 1603
For 300 ohm twin lead
Price: $10.60

Drake TV-75-HP
Model No. 1610
For 75 ohm TV coaxial cable; TV type connectors installed
Price: $13.25

DRAKE TV-3300-LP
1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. Helps TV i-f interference, as well as TV front-end problems. Price: $26.60 Model No. 1608

LOW PASS FILTERS FOR TRANSMITTERS
have four pi sections for sharp cut off below channel 2, and to attenuate transmitter harmonics falling in any TV channel and fm band. 52 ohm. SO-239 connectors built in.

DRAKE TV-5200-LP
200 watts to 52 MHz. Ideal for six meters. For operation below six meters, use TV-3300-LP or TV-42-LP.
Model No. 1609 Price: $26.60

DRAKE TV-42-LP Model No. 1605
is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for transmitters operating at 30 MHz and lower. Rated 100 watts input. Price: $14.60

Tufts Radio Electronics ● 209 Mystic Avenue ● Medford MA 02155 ● (617) 395-8280

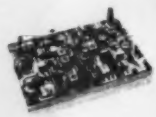
TUFTS RADIO CATALOG TUFTS RADIO

WORK ALL REPEATERS WITH OUR NEW SYNTHESIZER II

The Synthesizer II is a two meter frequency synthesizer. Frequency is adjustable in 5 kHz steps from 140.00 MHz to 149.995 MHz with its digital readout thumb wheel switching. Transmit offsets are digitally programmed on a diode matrix, and can range from 10 kHz to 10 MHz. No additional components are necessary!

Kit . . . . . $169.95 Wired and tested $239.95

RECEIVERS



RX28C	28-35 MHz FM receiver with 2 pole 10.7 MHz crystal filter	$ 59.95
RX28C W/T	same as above–wired & tested	104.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX50C W/T	same as above–wired & tested	104.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T	same as above–wired & tested	114.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX220C W/T	same as above–wired & tested	114.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RX432C W/T	same as above–wired & tested	124.95

TRANSMITTERS

TX50	transmitter exciter, 1 watt, 6 mtr	39.95
TX50 W/T	same as above–wired & tested	59.95
TX144B Kit	transmitter exciter–1 watt–2 mtrs	29.95
TX144B W/T	same as above–wired & tested	49.95
TX220B Kit	transmitter exciter–1watt–220 MHz	29.95

POWER AMPLIFIERS

PA2501H Kit	2 mtr power amp -kit 1w in–25w out with solid state switching, case, connectors	59.95
PA2501H W/T	same as above–wired & tested	74.95
PA4010H Kit	2 mtr power amp–10w in–40w out–relay switching	59.95
PA4010H W/T	same as above–wired & tested	74.95
PA50/25 Kit	6 mtr power amp, 1w in, 25w out, less case, connectors & switching	49.95
PA50/25 W/T	same as above, wired & tested	69.95
PA144/15 Kit	2 mtr power amp–1w in–15w out–less case, connectors and switching	39.95
PA144/25 Kit	same as PA144/15 kit but 25w	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit	power amp–similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10 W/T	10w in–140w out–2 mtr amp	179.95
PA140/30 W/T	30w in–140w out–2 mtr amp	159.95

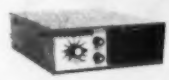
POWER SUPPLIES

PS15C Kit	15 amp–12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above–wired & tested	94.95
PS25C Kit	25 amp–12 volt regulated power supply w/case, w/fold-back current limiting and ovp	129.95
PS25C W/T	same as above–wired & tested	149.95
PS25M Kit	same as PS25C with meters	149.95
PS25M W/T	same as above–wired & tested	169.95

REPEATERS

RPT50 Kit	repeater–6 meter	465.95
RPT50	repeater–6 meter, wired & tested	695.95
RPT144 Kit	repeater–2 mtr–15w–complete (less crystals)	465.95
RPT220 Kit	repeater–220 MHz–15w–complete (less crystals)	465.95
RPT432 Kit	repeater–10 watt–432 MHz (less crystals)	515.95
RPT144 W/T	repeater–15 watt–2 mtr	695.95
RPT220 W/T	repeater–15 watt–220 MHz.	695.95
RPT432 W/T	repeater–10 watt–432 MHz.	749.95
DPLA50	6 mtr close spaced duplexer	575.00

TRANSCEIVERS

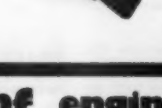


TRX50 Kit	Complete 6 mtr FM transceiver kit, 20w out, 10 channel scan with case (less mike and crystals)	249.95
TRX144 Kit	same as above, but 2 mtr & 15w out	219.95
TRX220 Kit	same as above except for 220 MHz	219.95
TRX432 Kit	same as above except 10 watt and 432MHz	254.95
TRC-1	transceiver case only	19.95
TRC-2	transceiver case and accessories	39.95

SYNTHESIZERS

SYN II Kit	2 mtr synthesizer, transmitt offsets programmable from 100 KHz–10 MHz, (Mars offsets with optional adapters)	169.95
SYN II W/T	same as above–wired & tested	239.95
MO-1 Kit	Mars/cap offset optional	2.50
TO-1 Kit	18 MHz optional tripler	2.50

WALKIE-TALKIES



HT 144B Kit	2 mtr, 2w, 4 channel, hand held receiver with crystals for 146.52 simplex	129.95
NICAD	battery pack, 12 VDC, ½ amp	29.95
BC12	battery charger for above	5.95
Rubber Duck	2 mtr, with male BNC connector	8.95

RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	8.50
RF28 Kit	10 mtr RF front end 10.7 MHz out	12.50
RF50 Kit	6 mtr RF front end 10.7 MHz out	12.50
RF144D Kit	2 mtr RF front end 10.7 MHz out	17.50
RF220D Kit	220 MHz RF front end 10.7 MHz out	17.50
RF432 Kit	432 MHz RF front end 10.7 MHz out	27.50
IF 10.7F Kit	10.7 MHz IF module includes 2 pole crystal filter	27.50
FM455 Kit	455 KHz IF stage plus FM detector	17.50
AS2 Kit	audio and squelch board	15.00

TX220B W/T	same as above–wired & tested	49.95
TX432B Kit	transmitter exciter 432 MHz	39.95
TX432B W/T	same as above–wired & tested	59.95
TX150 Kit	300 milliwatt, 2 mtr transmitter	19.95
TX150 W/T	same as above–wired & tested	29.95

Blue Line . . . RF power amp, wired & tested, emission–CW-FM-SSB/AM

Model	Frequency	Power Input	Power Output	
BLB 3/150	45-55MHz	3W	150W	TBA
BLC 10/70	140-160MHz	10W	70W	139.95
BLC 2/70	140-160MHz	2W	70W	159.95
BLC 10/150	140-160MHz	10W	150W	259.95
BLC 30/150	140-160MHz	30W	150W	239.95
BLD 2/60	220-230MHz	2W	60W	159.95
BLD 10/60	220-230MHz	10W	60W	139.95
BLD 10/120	220-230MHz	10W	120W	259.95
BLE 10/40	420-470MHz	10W	40W	139.95
BLE 2/40	420-470MHz	2W	40W	159.95
BLE 30/80	420-470MHz	30W	80W	259.95
BLE 10/80	420-470MHz	10W	80W	289.95

O.V.P.	adds over voltage protection to your power supplies, 15 VDC max.	9.95
PS3A Kit	12 volt–power supply regulator card with fold-back current limiting	8.95
PS3012 W/T	new commercial duty 30 amp 12 VDC regulated power supply w/case, w/fold-back current limiting and overvoltage protection	239.95

DPLA144	2 mtr, 600 KHz spaced duplexer, wired and tuned to frequency	379.95
DPLA220	220 MHz duplexer, wired and tuned to frequency	379.95
DPLA432	rack mount duplexer	319.95
DSC-U	double shielded duplexer cables with PL259 connectors (pr.)	25.00
DSC-N	same as above with type N connectors (pr.)	25.00

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching	$ 6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
CD3 Kit	UHF version of CD1 deck, needed for 432 multi-channel operation	12.95
COR2 Kit	carrier operated relay	19.95
SC3 Kit	10 channel auto-scan adapter for RX with priority	19.95
Crystals	we stock most repeater and simplex pairs from 146.0-147.0 (each)	5.00
CWID Kit	159 bit, field programmable, code identifier with built-in squelch tail and ID timers	39.95
CWID	wired and tested, not programmed	54.95
CWID	wired and tested, programmed	59.95
MIC 1	2,000 ohm dynamic mike with P.T.T. and coil cord	12.95
TS1 W/T	tone squelch decoder	59.95
TS1 W/T	installed in repeater, including interface accessories	89.95
TD3 Kit	2 tone decoder	29.95
TD3 W/T	same as above–wired & tested	39.95
HL144 W/T	4 pole helical resonator, wired & tested, swept tuned to 144 MHz ban	24.95
HL220 W/T	same as above tuned to 220 MHz ban	24.95
HL432 W/T	same as above tuned to 432 MHz ban	24.95

Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS AND EQUIPMENT

Tufts Radio Electronics ● 209 Mystic Avenue ● Medford MA 02155 ● (617) 395-8280

TUFTS RADIO CATALOG TUFTS RADIO

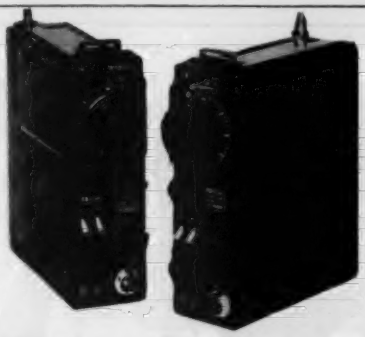
Now It's Crystal Clear

Yes, now ICOM helps you steer clear of all the hassles of channel crystals. The new IC-225 is the same surprising radio you've come to know and love as the IC-22A, except that it is totally crystal independent. Zero crystals. Solid state engineering enables you to program 23 channels of your choice without waiting. Now the ICOM performance you've demanded comes with the convenience you've wanted, with your new IC-225.

Price: $299.00

IC-245 Transceiver
The VFO Revolution goes mobile with the unique, ICOM developed LSI synthesizer with 4 digit LED readout. The IC-245 offers the most for mobile on the market. The easy to use tuning knob moves accurately over 50 detent steps and assures excellent control as easily as steering the vehicle. With its optional adapter, the IC-245 puts you into all mode operation on 12V DC power with a compact dash-mounted transceiver. In FM, the synthesizer command frequency is displayed in 5 kHz steps from 146 to 148 MHz, and with the side band adapter the step rate drops to 100 Hz from 144 to 146 MHz. For maximum repeater flexibility, the transmit and receive frequencies are independently programmable on any separation. The IC-245 even comes equipped with a multiple pin Molex connector for remote control. The IC-245 is a product of the revolution in VFO design, from its new style front panel, to its excellent mechanical rigidity and Large Scale Integrated Circuitry. Your IC-245 will give you the most for mobile. $499.00

THE NEW ICOM 4 MEG, MULTI-MODE, 2 METER RADIO — IC 211
ICOM introduces the first of a great new wave of amateur radios, with new styling, new versatility, new integration of functions. You've never before laid eyes on a radio like the IC-211, but you'll recognize what you've got when you first turn the single-knob frequency control on this compact new model. The IC-211 is fully synthesized in 100 Hz or 5 kHz steps, with dual tracking, optically coupled VFOs displayed by seven-segment LED readouts, providing any split. The IC-211 rolls through 4 megahertz as easily as a breaker through the surf. With its unique ICOM developed LSI synthesizer, the IC-211 is now the best "do everything" radio for 2 meters, with FM, USB, LSB and CW operation. $749.00



Hold it!

Take hold of SSB with these two low cost twins. ICOM'S new portable IC-202 and IC-502 put it within your reach wherever you are. You can take it with you to the hill top, the highways, or the beach. Three portable watts PEP on two meters or six!

Hello, DX! The ICOM quality and excellent receiver characteristics of this pair make bulky converters and low band rigs unnecessary for getting started in SSB-VHF. You just add your linear amp, if you wish, connect to the antenna, and DX! With the 202 you may talk through OSCAR VI and VII! Even transceive with an "up" receiving converter! The IC-502, similarly, makes use of six meters in ways that you would have always liked but could never have before. In fact, there are so many things to try, it's like opening a new band.

Take hold of Single Side Band. Take hold of some excitement. Take two.

IC-202
2 Meter SSB • 3 Watts PEP • True IF Noise Blanker Switched Dial Lights • Internal Batteries • 500KHz VXO Tuning • 144.0, 144.2 • 2 Mems! • INT!
Price: $259.00

IC-502
6 Meter SSB • 3 Watts PEP • True IF Noise Blanker Switched Dial Lights • Internal Batteries • 500KHz VFO • INT!
Price: $249.00

Now ICOM Introduces 15 Channels of FM to Go!

The New IC-215: the FM Grabber

This is ICOM's first FM portable, and it puts good times on the go. Change vehicles, walk through the park, climb a hill, and ICOM quality FM communications go right along with you. Long lasting internal batteries make portable FM really portable, while accessible features make conversion to external power and antenna fast and easy.

Grab for flexibility with the new **IC-215** FM portable.

- Front mounted controls and top mounted antenna
- Narrow filter (15KHz — compatible spacing)
- 15 channels (12 on dial - 3 priority)
- Push, collapsible antenna
- Compatible mount feature for flexible antenna
- Dual power (3 watts high / 400 mw low, nominal)
- External power and antenna easily accessible
- Lighted dial and meter

Price: $220.00

Your new IC-215 comes supplied with 5 popular channels, handheld mic, with protective case, shoulder strap, connectors for external power and speaker, 9 long-life C batteries.

ICOM

TUFTS RADIO CATALOG TUFTS RADIO

Tufts Radio Electronics ● 209 Mystic Avenue ● Medford MA 02155 ● (617) 395-8280

model 333
dummy load
wattmeter

Favorite Lightweight Portable—250 WATT RATING—Air Cooled

Ideal field service unit for mobile 2-way radio—CB, marine, business band. Best for QRP amateur use, CB, with zero to 5 watts full scale low power range.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	250 watts intermittent
Wattmeter Ranges	0–5, 0–50, 0–125, 0–250
Connector	SO-239
Size	4" x 7" x 8"
Shipping Weight	2 lbs.
Price	$98.50

model 374 dummy load wattmeter

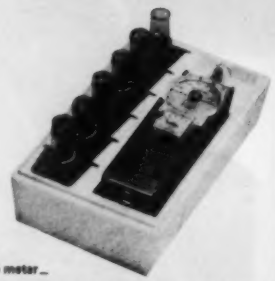
Top of the Line—1500 WATT RATING—Oil Cooled

Our highest power combination unit. Rated to 1500 watts input (intermittent). Meter ranges are individually calibrated for highest accuracy.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts DC intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0–15, 0–50, 0–300, 0–1500
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$215.00

LITTLE DIPPER



model 331A
transistor dip meter_

Portable RF single generator, signal monitor, or absorption wavemeter. Lightweight (1 pound, 6 ounces with all coils), battery-powered unit is ideal for field use in testing transceivers, tuning antennas, etc. Can also be used to measure capacity, inductance, circuit Q, and other factors. Indispensable for experimenters, it is easily the most versatile instrument in the shop. Continuous coverage from 2 MHz to 230 MHz in seven ranges.

Unit consists of a transistorized RF dip oscillator and 100-microampere meter circuit. Meter circuit uses a single-transistor DC amplifier with a potentiometer in the emitter circuit to control meter sensitivity. A 3-position slide switch connects the meter circuit to the oscillator for dip measurements, to a diode for absorption wavemeter peak measurements, or provides audio modulation of the RF signal.

Frequency dial has a calibrated reference point for Q and bandwidth measurements. Each coil has its own frequency dial: there's no confusion with multiple markings or small, hard-to-read scales near the center of the dial.

• specifications

Frequency Coverage	2 MHz to 230 MHz in 7 overlapping ranges by plug-in coil assemblies: 2 MHz–4 MHz, 4 MHz–8 MHz, 8 MHz–16 MHz, 16 MHz–32 MHz, 32 MHz–64 MHz, 50 MHz–110 MHz, 110 MHz–230 MHz
Accuracy	±3%
Modulation	1000 Hz, 25% to 40%
Power	9-volt transistor battery, Burgess 2U6 or equivalent
Size	7" x 2-1/4" x 2-1/2"
Shipping Weight	1 lb., 6 oz.
Price	$120.00

B&W BARKER & WILLIAMSON, INC.

Economy High Power Load—1500 WATT RATING—Oil Cooled
model 384 dummy load

For high power when all you need is the load.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1500 watts intermittent. Warning light* signals maximum heat limit.
Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/2"
Shipping Weight	12 lbs.
Price	$94.50

High Power—1000 WATT RATING—Oil Cooled
model 334A dummy load wattmeter.

Our most popular combination unit. Handles full amateur power. Meter ranges individually calibrated. Can be panel mounted.

• specifications

Frequency Range	DC to 300 MHz
VSWR	Less than 1.3:1 to 230 MHz
Power Range	1000 watts CW intermittent. Warning light* signals maximum heat limit.
Wattmeter Ranges	0–10, 0–100, 0–300, 0–1000
Input Connector	SO-239 (hermetically sealed)
Size	4-3/4" x 9" x 10-1/4"
Shipping Weight	12 lbs.
Price	$174.00

WIDE RANGE ATTENUATOR

Model 371-1

Protect your receiver or converter from overload, or provide step attenuation of low-level RF signals from signal generators, preamplifiers, or converters. Seven rocker switches provide attentuation from 1 dB to 61 dB in 1-dB steps. Switches are marked in dB, 1-2-3-5-10-20-20. Sum of actuated switches (IN position) gives attenuation. With all switches in OUT position, there is NO insertion loss. Attenuator installs in coaxial line using UHF connectors.

• specifications

Power Capacity	1/4 watt
VSWR	1.3:1 maximum, DC to 225 MHz
Impedance	50 ohms
Accuracy	1 dB/dB, DC to 60 MHZ 0.1 dB/dB ±0.5 dB, DC to 160 MHz 0.1 dB/dB ±1.0 dB, DC to 225 MHz
Size	3-1/2" x 2-1/2" x 2-1/4"
Shipping Weight	1-1/2 lbs.
Price	$49.50

-C – LINE AMATEUR EQUIPMENT — DRAKE — COMMUNICATIONS RECEIVERS-

Drake R-4C

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. In addition to the ham bands, tunes any fifteen 500 kHz ranges between 1.5 and 30 MHz, 5.0 to 6.0 MHz not recommended. Can be used for MARS, WWV, CB, Marine and Shortwave broadcasts.

Superior selectivity: 2.4 kHz 8-pole filter provided in ssb positions. 8.0 kHz, 6 pole selectivity for a-m. Optional 8-pole filters of .25, .5, 1.5 and 6.0 kHz bandwidths available.

Tunable notch filter attenuates carriers within passband.

Smooth and precise passband tuning.

Transceive capability; may be used to transceive with the T-4X, T-4XB or T-4XC Transmitters. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Agc with fast attack and two release times for ssb and a-m or fast release for break-in cw. Agc also may be switched off.

New high efficiency accessory noise blanker that operates in all modes.

Crystal lattice filter in first i-f prevents cross-modulation and desensitization due to strong adjacent channel signals.

Excellent overload and intermodulation characteristics.

25 kHz Calibrator permits working closer to band edges and segments.

Scratch resistant epoxy paint finish.

Price: $599.00

Drake T-4XC

Solid State Linear permeability-tuned VFO with 1 kHz dial divisions. Gear driven dual circular dials. High mechanical, electrical and temperature stability.

Covers ham bands with crystals furnished. Covers all of 80, 40, 20 and 15 meters, and 28.5-29.0 MHz of 10 meters.

Covers 160 meters with accessory crystal. Four 500 kHz ranges in addition to the ham bands plus one fixed-frequency range can be switch-selected from the front panel.

Two 8-pole crystal lattice filters for sideband selection.

Transceives with the R-4, R-4A, R-4B, R-4C and SPR-4 Receivers. Switch on the T-4XC selects frequency control by receiver or transmitter PTO or independently. Illuminated dial shows which PTO is in use.

Usb, lsb, a-m and cw on all bands.

Controlled-carrier modulation for a-m is compatible with ssb linear amplifiers.

Automatic transmit-receive switching. Separate VOX time-delay adjustments for phone and cw. VOX gain is independent of microphone gain.

Choice of VOX or PTT. VOX can be disabled by front panel switch.

Adjustable pi network output.

Transmitting agc prevents flat-topping.

Meter reads relative output or plate current with switch on load control.

Built-in cw sidetone.

Spotting function for easy zero-beating.

Easily adaptable to RTTY, either fsk or afsk.

Compact size; rugged construction. Scratch resistant epoxy paint finish.

Price: $599.00

Drake SPR-4 – $629.00

- **Programmable to meet specific requirements: SWL, Amateur, Laboratory, Broadcast, Marine Radio, etc.**
- **Direct frequency dialing: 150-500 kHz plus any 23 500 kHz ranges, 0.5 to 30 MHz**
- **FET circuitry, all solid state**
- **Linear dial, 1 kHz readout**
- **Band-widths for cw, ssb, a-m with built-in LC filter**
- **Crystals supplied for LW, seven SW, and bc bands**
- **Notch filter**
- **Built-in speaker**

Drake DSR-2 – $2950.00

- **Continuous Coverage 10 kHz to 30 MHz**
- **Digital Synthesizer Frequency Control**
- **Frequency Displayed to 100 Hz**
- **All Solid State**
- **A-m, Ssb, Cw, RTTY, lsb**
- **Series Balanced Gate Noise Blanker**
- **Front End Protection**
- **Optional Features Available on Special Order**

Power Supplies

Power Supplies for T-4, T-4X, T-4XB or T-4XC (The AC-4 can be housed in an MS-4 speaker cabinet).

Model No. 1501 Drake AC-4 $120.00
Model No. 1505 Drake DC-4 $135.00

Drake MS-4

Drake MS-4 Matching Speaker for use with R-4, R-4A, R-4B and R-4C Receivers. (Has space to house AC-3 and AC-4 Power Supplies) **Price: $24.95**

Accessories

DRAKE MICROPHONES

Wired for use with Drake transmitters and transceivers, for either push-to-talk or VOX. Type of operation is determined by the VOX control setting of the transmitter.

Desk Type Model No. 7075

• **Type:** Heavy Duty Ceramic Desk Top • **Cable:** Four Foot, 3-Conductor, One Shield • **Output Level:** Minus 54 dB (0 dB = 1 volt/microbar) • **Frequency Response:** 80-7000 Hz • **Switching:** Adapts to either push-to-talk or VOX. **Price: $39.00**

Hand-Held Type Model No. 7072

• **Type:** Ceramic, hand held • **Cable:** 11' Retracted, 5' extended, PVC 3 Cord, 1 shielded, Coil Cord • **Case:** Cycolac • **Finish:** Grey • **Output Level:** Minus 65 dB (0 dB = 1 volt/microbar) • **Frequency Response:** 300-3000 Hz • **Switching:** Adapts to either push-to-talk or VOX.

Price: $19.00

Drake FS-4
Digital Synthesizer – $250.00

The new solid state Drake FS-4 Synthesizer opens the door to a new world of continuous-tuning short wave! Combines synthesized general coverage flexibility with the selectivity, stability, frequency readout and reliability of the Drake R-4C or SPR-4 Receivers.

• Interfaces with all R-4 series receivers and T-4X series transmitters: (R-4, R-4A, R-4B, R-4C, SPR-4, T-4, T-4X, T-4XB and T-4XC), without modification. • MHz range is set on FS-4, with kHz readout taken from receiver dial. • Complete general coverage—no range crystals to buy. • T-4/T-4X series transmitters transceive on any FS-4 frequency, when used with R-4 series receivers. • Readout 1 kHz with Drake PTO.

Price: $250.00

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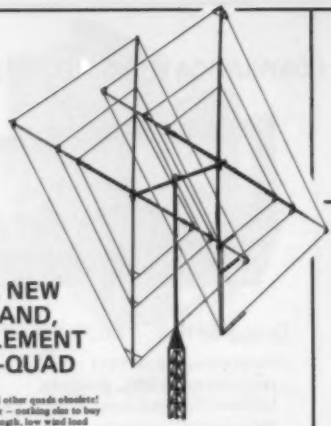
TUFTS RADIO CATALOG TUFTS RADIO

TUFTS RADIO CATALOG TUFTS RADIO



ALL NEW 3–BAND, 2 ELEMENT HY–QUAD

- Makes all other quads obsolete!
- Complete – nothing else to buy
- High strength, low wind load

The Hy-Quad from Hy-Gain makes all other quads obsolete! Here's why:
First, it's the only quad that is complete. There is nothing more to shop for or buy.
Secondly, it is uniquely designed so that it overcomes all of the previously undesirable features inherent in quads.
The all aluminum structure stays up! The single feed line and diamond shape simplifies feed line coupling.
Hy-Gain's all new Hy-Quad will outdo all other quads because it's engineered to do just that. The Hy-Quad is new, it's superior, it's complete. It's the first quad to have everything: spreaders are broken up at strategic electrical points with Cyclac insulators / tri-band 2 element construction with individually resonated elements with no interaction / Hy-Quad requires only one feed line for all three bands / individually tuned gamma matches on each band with Hy-Gain exclusive vernier feed / full wave element loops require no tuning stubs, traps, loading coils or baluns / heavy duty mechanical construction of strong swaged aluminum tubing and die formed spreader-to-boom clamps / extra heavy duty universal boom-to-mast clamp that tilts and mounts on any mast 1¼" to 2½" in diameter / aluminum stranded wire. You can open and close the bands with this antenna. You'll experience the thrill of real DX.

Order No. 244 Price: $219.95

SPECIFICATIONS

Overall length of spreaders	29'9"	Forward gain	8.5 db
Turning radius	13'6"	Input impedance	52 ohms
Weight	42 lbs.	VSWR	1.2:1 or better at resonance on all bands
Boom diameter	2"		
Boom length	8'	Power	Maximum legal
Mast diameter	1¼" to 2½"		
Wind survival	100 mph	Front-to-back ratio	25-35 db depending upon electrical height
Surface area	6.4 sq. ft.		
Wind load at 100 mph	256.0 lbs.	Polarization	Horizontal

The Versatile Model 18V for 80 thru 10 Meters

The Model 18V is a low-cost, highly efficient vertical antenna that can be tuned to any band - 80 thru 10 meters - by a simple adjustment of the feed point on the matching base inductor. Fed with 52 ohm coax, this 18 ft. radiator is amazingly efficient for DX or local contact. Constructed of heavy gauge aluminum tubing, theModel 18V may be installed on a short 1¼ inch mast driven into the ground. It is also adaptable to roof or tower mounting. Highly portable, the Model 18V can be quickly knocked down to an overall length of 5 ft. and easily re-assembled for field days and camping trips. Shpg. Wt., 5 lbs.
Order No. 193 Price: $33.00

WIDE BAND VERTICAL for 80 - 10 Meters Hy-Gain's 18 AVT/WB

Take the wide band, omni-directional performance of Hy-Gain's famous 14AVQ/WB, add 80 meter capability plus extra-heavy duty construction – and you have the unrivalled new 18AVT/WB. In other words, you have quite an antenna.

- Automatic switching, five band capability is accomplished through the use of three beefed-up Hy-Q traps (featuring large diameter coils that develop an exceptionally favorable L/C ratio).
- Top loading coil.
- Across-the-band performance with just one furnished setting for each band (10 through 40).
- True 1/4 wave resonance on all bands.
- SWR of 2:1 or less at band edges.
- Radiation pattern has an outstandingly low angle whether roof top or ground mounted.

CONSTRUCTION . . . of extra-heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at slotted tubing joints . . . is so rugged and rigid that, although the antenna is 25' in height, it can be mounted without guy wires, using a 12" double grip mast bracket, with recessed coax connecter.

Order No. 386 Price: $97.00

hy-gain

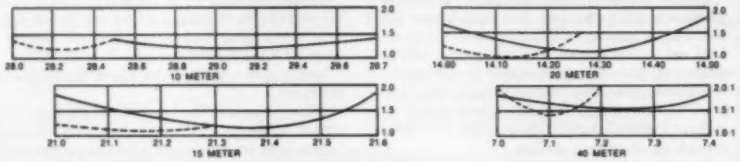
For 10, 15, and 20 Meters
New Hy-Gain Model 12 AVQ

Completely self-supporting, the Model 12AVQ features Hy-Q traps...12" double-grip mast bracket...taper swaged seamless aluminum construction with full circumference compression clamps at tubing joints. It delivers outstanding low angle radiation. SWR is 2:1 or less on all bands. Overall height is 13'6". Shipping weight 7.2 lbs. Price: $47.00
Order No. 384

New, improved successor to the world's most popular vertical!
Hy-Gain Model 14 AVQ/WB for 40-10 Meters.
- **Wide band performance with one setting (optimum settings for top performance furnished)**
- **New Hy-Q Traps • New 12" Double-Grip Mast Bracket • Taper Swagged Seamless Aluminum Construction**

The Model 14AVQ/WB, new improved successor to the world famous Model 14AVQ, is a self-supporting, automatic band switching vertical that delivers omni-directional performance on 40 through 10 meters. Three separate Hy-Q traps featuring large diameter coils that develop an exceptionally favorable L/C ratio and a very high Q, provide peak performance by effectively isolating sections of the antenna so that a true 1/4 wave resonance exists on all bands. Outstandingly low angle radiation pattern makes DX and other long haul contacts easy. Superior mechanical features include solid aluminum housing for traps using air dielectric capacitor...heavy gauge taper swaged seamless aluminum radiator...full circumference compression clamps at tubing joints that are resistant to corrosion and wear...and a 12" double-grip mast bracket that insures maximum rigidity whether roof-top or ground mounted. The Model 14AVQ/WB also delivers excellent performance on 80 meters using Hy-Gain Model LC-80Q Loading Coil. Overall height is 18 feet. Shipping weight 9.2 lbs. Unsurpassed portability...outstanding for permanent installations. Price: $67.00
Order No. 385

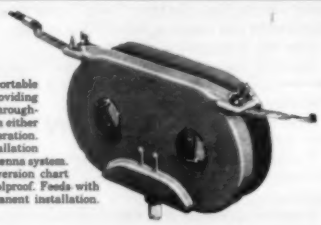
TYPICAL 14AVQ/WB VSWR CURVES



ROOF MOUNTING KIT – Model 14RMQ provides rugged support for Model 14AVQ/WB.
Order No. 184 Price: $24.95

Hy-Gain REEL TAPE PORTABLE DIPOLE for 10 thru 80 Meters Model 18TD

The most portable high performance dipole ever...



The Model 18TD is unquestionably the most foolproof high performance portable doublet antenna system ever developed. It has proven invaluable in providing reliable communications in vital military and commercial applications throughout the world. Two stainless steel tapes, calibrated in meters, extend from either side of the main housing up to a total distance of 132 feet for 3.5 mc operation. 25 ft. lengths of polypropylene rope attached to each tape permits installation to poles, trees, buildings...whatever is available for forming a doublet antenna system. Integrated in the high impact housing is a frequency to length conversion chart calibrated to meter measurements on the tapes...makes installation foolproof. Feeds with 52 ohm coax. Delivers outstanding performance as a portable or permanent installation. Measures 10x5½x2 inches retracted. Wt., 4.1 lbs.
Order No. 228 Price: $94.95

DenTron MLA-2500 $799.50

DenTron Radio has packed all the features a linear amplifier should have into their new MLA-2500. Any Ham who works it can tell you the MLA-2500 really was built to make amateur radio more fun.

- ALC circuit to prevent overloading
- 160 thru 10 meters
- 1000 watts DC input on CW, RTTY or SSTV Continuous Duty
- Variable forced air cooling system
- Self-contained continuous duty power supply
- Two EIMAC 8875 external anode ceramic/metal triodes operating in grounded grid
- Covers MARS frequencies without modifications
- 50 ohm input and output impedance
- Built-in RF wattmeter
- 117V or 234V AC 50-60 hz
- Third order distortion down at least 30 db
- Frequency range:
  1.8MHz (1.8-2.5) 3.5MHz (3.4-4.6)
  7MHz (6.0-9.0) 14MHz (11.0-16.0)
  21MHz (16.0-22.0) 28MHz (28.0-30.0)
- 40 watts drive for 1 KW DC input
- Rack mounting kit available (19" rack)
- Size: 5½" H x 14" W x 14" D Wt. 47 lbs.

Pipo Communications TROUBLE FREE TOUCH-TONE ENCODER

POSITIVE TOUCH (KEYS DEPRESS) • MOBILE • HANDHELD
DESK MOUNT • NO POTTED PARTS (SERVICEABLE)
MIL. SPEC. COMPONENTS • NO RFI • SELF CONTAINED
XTAL CONTROLLED • LEVEL ADJUSTABLE FROM FRONT
Pat. Pend.

PP-1

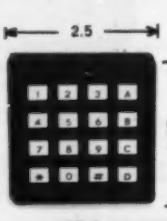
All series is for mounting to surfaces inaccessable from the rear; exits - mobiles - systems interface - panels - test equipment, etc.

K series is self contained with a relay inside the encoder. When Keys are pressed contact closer occurs with a 2 sec. delay, (adjustable). Contacts are rated at 110ma @ 28 Volts switched, 500ma carry. PP-2K contains delay exclusion for the forth column. However, by jumpering D-5, 4th column delay is removed.

Pipo Communications has developed a trouble free reliable instrument to be free of any defects for years. Unit is constructed with the best components available, without compromise in quality. Unit is operable from 4.5 - 60 Volts at temperatures from below 0 to + 140°F. Output level will drive any transmitter or system. Adjustable output level is controlled with an extremely stable multiturn trimpot, with access from the front of the encoder (not behind), saving time for level setting, which amounts to hours when involved with a system.

PP-1	$60	12 Keys	PP-2	$80	16 Keys
PP-1m	$65	Lettering Optional	PP-2m	$85	Lettering Optional
PP-1K	$80	Add $1.50	PP-2K	$80	Add $1.50

PP-1A $60 For Standard Comm. Hand Held



PP-2

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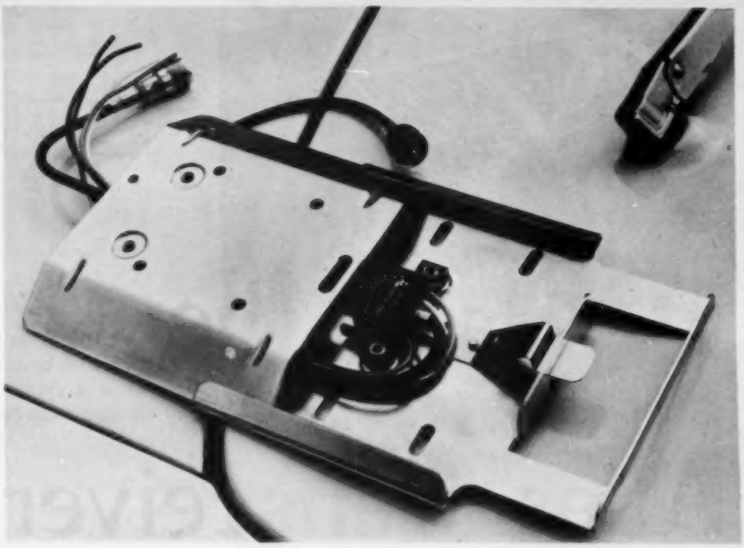
STOP A THIEF!

SAVE YOUR RADIO!



DESIGNED FOR COMMERCIAL USE UP TO 1000 MHZ.

The **TUFTS SAVE-YOUR-RADIO** bracket can save you a bundle . . . and a lot of hassle. Why worry about rig ripoff? The **TUFTS SYR** bracket mounts quickly and easily in your car and makes it possible to snap your rig out of its bracket when you park and put it out of sight.

The connector system has a special coaxial cable connector which will provide you with a lossless connection right up to 1000 MHz! No loss! In addition to the quick coax connector there are also four power and accessory connections which are made automatically when the rig is slid into its bracket . . . just what you need for feeding power and loudspeaker connections to the set.

This is a rugged bracket and connector system . . . it'll take a beating. There is a hole on each side of the 16 gauge steel plate for a padlock in case you want to leave the rig for short periods in its bracket. They'll have to rip out the dash to get it . . . and it won't be the first time for that.

With two of these brackets you can bring the mobile rig into the house and use it in seconds. On trips you can take an AC supply for the rig and use it in your hotel room. Price: $29.95

400% MORE RF POWER
PLUGS BETWEEN YOUR MICROPHONE AND TRANSMITTER

$49.95

LSP-520BX. 30 db dynamic range IC log amp and 3 active filters give clean audio. RF protected. 9 V battery. 3 conductor, ¼" phone jacks for input and output. 2-3/16 x 3-1/4 x 4 inches.

$59.95

LSP-520BX II. Same as LSP-520BX but in a beautiful 2-1/8 x 3-5/8 x 5-9/16 inch Ten-Tec enclosure with uncommitted 4 pin Mic jack, output cable, rotary function switch.

$27.95

CWF-2BX Super CW Filter

By far the leader. Over 5000 in use. Razor sharp selectivity. 80 Hz bandwidth, extremely steep skirts. No ringing. Plugs between receiver and phones or connect between audio stage for speaker operation.

• Selectable BW: 80, 110, 180 Hz • 60 dB down one octave from center freq. of 750 Hz for 80 Hz BW • Reduces noise 15 dB • 9 V battery • 2-3/16 x 3-1/4 x 4 in. • CWF-2PC, wired PC board, $18.95 • CWF-2PCK, kit PC board $15.95

$49.95

CMOS-8043 Electronic Keyer

State of the art design uses CURTIS-8043 Keyer-on-a-chip.

• Built-in Key • Dot memory • Iambic operation with external squeeze key • 8 to 50 WPM • Sidetone and speaker • Speed, volume, tone, weight controls • Ultra reliable solid state keying +300 volts max. • 4 position switch for TUNE, OFF, ON, SIDETONE OFF • Uses 4 penlight cells • 2-3/16 x 3-1/4 x 4 inches

$29.95

SBF-2BX SSB Filter

Dramatically improves readability.

• Optimizes your audio to reduce sideband splatter, remove low and high pitched QRM, hiss, static crashes, background noise, 60 and 120 Hz hum • Reduces fatigue during contest, DX, and ragchewing • Plugs between phones and receiver or connect between audio stage for speaker operation • Selectable bandwidth IC active audio filter • Uses 9 volt battery • 2-3/16 x 3-1/4 x 4 inches

$27.95

MFJ-200BX Frequency Standard

Provides strong, precise markers every 100, 50, or 25 KHz well into VHF region.

• Exclusive circuitry suppresses all unwanted markers • Markers are **gated** for positive identification. CMOS IC's with transistor output. • No direct connection necessary • Uses 9 volt battery • Adjustable trimmer for zero beating to WWV • Switch selects 100, 50, 25 KHz or OFF • 2-3/16 x 3-1/4 x 4 inches

SUPER LOGARITHMIC SPEECH PROCESSOR

Up to 400% More RF Power is yours with this plug-in unit. Simply plug the MFJ Super Logarithmic Speech Processor between your microphone and transmitter and your voice is suddenly transformed from a whisper to a **Dynamic Output.**

Your signal is full of punch with power to slice through QRM and you go from barely readable to "solid copy OM."

39.95 NEW

MFJ-16010 Antenna Tuner

Now you can operate all band — 160 thru 10 Meters — with a single random wire and run your full transceiver power output — up to 200 watts RF power OUTPUT.

• Small enough to carry in your hip pocket, 2-3/16 x 3-1/4 x 4 inches • Matches low and high impedances by interchanging input and output • SO-239 coaxial connectors • Unique wide range, high performance, 12 position tapped inductor. Uses two stacked toroid cores

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For the Newcomer to learn the Morse code.
For the Old Timer to polish his fist.
For the Code Instructor to teach his classes.

• Send crisp clear code with plenty of volume for classroom use • Self contained speaker, volume, tone controls, aluminum cabinet • 9 V battery • Top quality U.S. construction • Uses 555 IC timer • 2-3/16 x 3-1/4 x 4 inches

TK-555, Optional Telegraph Key $1.95

$49.95

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Clearly copy weak unreadable signals (increases signal 3 to 5 "S" units).

• More than 20 dB low noise gain • Separate input and output tuning controls give maximum gain and RF selectivity to significantly reject out-of-band signals and reduce image responses • Dual gate MOS FET for low noise, strong signal handling abilities • Completely stable • Optimized for 10 thru 30 MHz • 9 V battery • 2-1/8 x 3-5/8 x 5-9/16 inches

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MFJ-40T QRP Transmitter

Work the world with 5 watts on 40 Meter CW.

• No tuning • Matches 50 ohm load • Clean output with low harmonic content • Power amplifier transistor protected against burnout • Switch selects 3 crystals or VFO input • 12 VDC • 2-3/16 x 3-1/4 x 4 inches

MFJ-40V, Companion VFO $27.95
MFJ-12DC, IC Regulated Power Supply, 1 amp, 12 VDC $27.95

73 Magazine Staff

Using the Atlas Transceiver

-- practical experiences

The Atlas 180/210 series of transceivers has been used by now in every conceivable type of portable and mobile application from bicycle portable on up. This article presents a few operating notes and simple modifications for the transceivers which have been developed out of experiences using several of the units over the past year.

Fig. 1. A size comparison between a 210 and a Globe-Union battery pack which will power the unit at almost full power for several hours of intermittent operation.

For fixed station operation, the transceiver can be powered from anything from an automobile storage battery to one of the power supplies sold by Atlas. The automobile battery approach costs about $30 for a suitable battery plus the cost of a commercial or home brew charger. A standard Sears 60-80 Ampere/hour (20 hour rate) battery will easily keep the rig going for 4 hours of operation at full power. A relay can automatically switch in the charger. The advantages are a completely hum-free power source and a rig that is always ready, even if commercial power fails. The only disadvantage is the need to observe the usual requirements for ventilation, etc., when charging the battery. Home brew transformer type power supplies can also be built as long as they can supply 8 Amperes continuously and 16 Amperes peak while holding the output voltage between 12 and 14 volts. A minimum of 25,000 mF output filtering is necessary to keep hum at an acceptable level.

Moving towards portable operation, several power supply options exist. Atlas does sell a compact $100 110/220 supply which weighs about 15 pounds and will supply full power input. Some amateurs who have been willing to operate portable at the opposite end of the power scale have taken out the speaker in the transceiver and installed a simple 12 V dc supply in the space that will power the rig to a few Watts.

Also, the approach has been used for QRP portable, using a hefty wall plug type transformer and then placing the power supply filter components around the speaker (leaving the speaker installed) for portable operation where ac is available. However, for reasonable power output and true portability at an economic price, some form of rechargeable battery pack is probably best. Nicad batteries, if they can be found at a suitable price from a surplus outlet, are always a good bet. 4.5 Ampere/hour units (20 hour rate) will power the transceiver, although a heftier size up to 7.5 Ampere/hours is preferred. The Eveready or Gould rechargeable batteries being sold to power portable TV sets are a good economical approach. Lastly, one can use a gelled electrolyte type battery pack (such as the Globe-Union GC-1200 type, available from Burstein-Applebee at $60.00) which

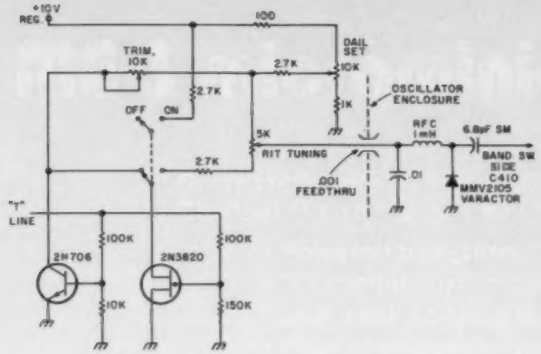


Fig. 2(a). This is the original RIT circuit developed for Atlas. Note the "Dial Set" capacitor is also replaced by a pot. With RIT on and RIT pot centered, zero beat calibrator signal with the "Dial Set" pot. With RIT off, zero beat signal with the 10k trimpot (mounted internally).

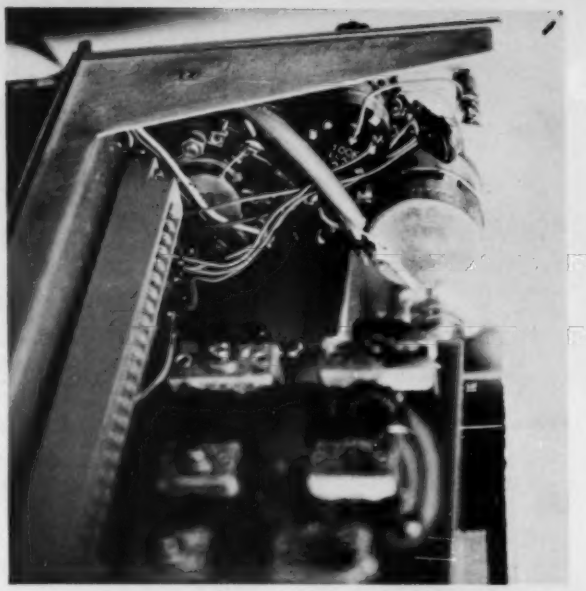


Fig. 2(b). This photo shows how the RIT potentiometer has been placed between the function switch and the ALC/MIC gain control. One of the trimpots for the RIT circuit is mounted directly on the potentiometer.

combines really compact size with good power capacity and a life of about 300/500 charge/discharge cycles. Such a battery pack is shown in Fig. 1 for a size comparison with the transceiver. The operating time that can be obtained from *any* battery setup depends on the input power level and the ratio of transmit to receive time. A QRP enthusiast can operate all night from a 4.5 Ampere/hour battery pack while, if using full power, the time would be about one hour. The microphone gain on the transceiver controls the PEP input level, of course, on SSB, but also the carrier level on CW. So, the decision is up to the operator as to the choice between operating time and the power input used.

Fig. 1 shows also an oversize tuning knob being used. The basic 15 kHz/revolution tuning rate seems to be convenient, but it is made even easier to use by a larger knob. A simple hole drilled partly into the knob with a large drill provides a simple "finger hole" for quick spin-type tuning across a band.

Improvements for SSB operation are hard to suggest for this rig. It has a fine sound on SSB and one of the sharpest filters used in an HF transceiver. But, a few simple items can improve operator convenience greatly. For instance, the aircraft pilot Plantronics type headsets, which essentially consist of a small transducer mounted over one ear with acoustic tube coupling for a pencil type microphone and a flexible tube fitting in the ear for a headphone, are now becoming available (see Godbout ads in *73*). These units are not cheap ($60), but they are excellent quality units, provide very sharp shaped speech response and, of course, provide complete "hands-free" operation. These headsets will be covered in some detail in a future article, but they are very easily adapted for use with the Atlas transceivers. Basically, the amplifier which comes with the headset need not be used, and the headphone element can be connected directly and the microphone element used via a 1k Ohm to 20k Ohm step-up audio transformer.

VOX is always a handy feature, especially for mobile operation. It can be added for $7.00! The key is the use of a simple Radio Shack "Science Fair" Voice Controlled Relay Kit no. 28-131. This kit is meant to be wired on a rather large perfboard moulded chassis, but it can be wired compactly on regular PC board and tucked in a corner of the transceiver. It was meant to be powered from a 9 volt battery, but operated well from the 12 volt line in the transceiver via a 220 Ohm dropping resistor. The kit, as it comes, has a sensitivity control, but not an adjustable time delay control. The latter feature is easily added by placing a 250k PC type potentiometer across C5 (the only 100 mF capacitor used in the kit). The relay that comes with the kit is wired to activate the PTT line. The first two stages of audio amplification used in the kit circuit can even do double duty as a microphone preamplifier, if desired.

Receiver Incremental Tuning (RIT) is one of those convenience features which can be debated on a transceiver. Obviously it is not needed for home station operation if a separate VFO console is purchased. It can be lived without for portable or mobile work, but it is handy to have. Atlas thought about RIT and paid to have a suitable circuit developed. But, how many controls, switches, etc., can you fit on the front panel of the Atlas rigs? For mobile operation, a noise blanker is a useful accessory, and Atlas opted to provide a front panel control for this accessory item. However, if the blanker is not installed, the available front panel space can be used to install an RIT circuit. The RIT circuit developed for Atlas is shown in Fig. 2(a). It is completely electronic. The MMV2105 varactor diode can be substituted by one from the Motorola MV series or even *some* ordinary 1N4001 rectifier diodes have worked. The original part, if you want it, is available for $1.50 from

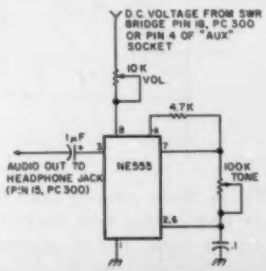
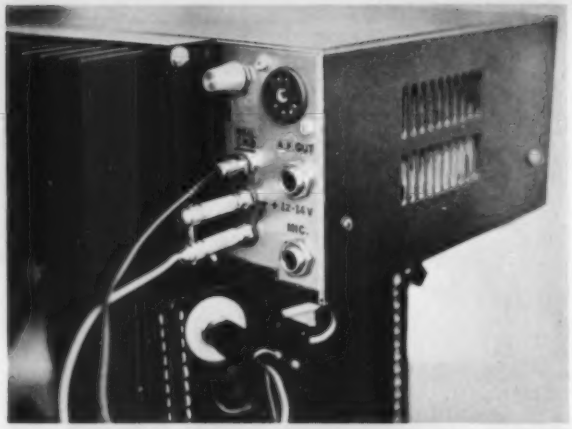

D.C. VOLTAGE FROM SWR BRIDGE PIN 10, PC 300 OR PIN 4 OF "AUX" SOCKET
10K VOL
4.7K
1μF
AUDIO OUT TO HEADPHONE JACK (PIN 15, PC 300)
NE555
100K TONE

Fig. 3. The NE555 does it again, this time as a simple CW monitor for the Atlas transceivers with adjustable tone.



This photo shows how a miniature pot can be mounted on the rear panel as a volume control for the CW monitor of Fig. 3. It also shows the method of connection for the transceiver to a battery pack for portable operation.

Circuit Specialists, P.O. Box 3047, Scottsdale AZ 85257. The 5k tuning control provides a plus/minus tuning range of several kHz, although it is not uniform on each band. The tuning control is mounted on the front panel between the microphone gain and function switches. The photo of Fig. 2(b) shows how the potentiometer is mounted behind the front panel and how one of the PC type adjustment pots is mounted. Since only dc wiring is involved *outside* the oscillator enclosure, some liberty can be taken in the placement of the various components. Inside the enclosure, the varactor diode and 6.8 pF coupling capacitor must be securely fastened. A miniature DPDT toggle switch can be mounted any place panel space is available to turn the RIT on and off, on a 5k tuning point can be added with a switch to control a DPDT relay performing the same function.

The Atlas rigs are oriented towards the phone man, but they can make an excellent CW rig. In fact, for a rig so extremely well suited for portable emergency operations, it is a pity that the most fundamental mode of emergency communication, CW, wasn't a bit more emphasized. However, a few features to make CW operation enjoyable are easily added.

If one wants to go all the way, a complete electronic keyer can be built into the rig, such as the miniature Mini-MOS keyer described by WA6EGY in the Aug. 76 *73*. This keyer includes a monitor which also nicely takes care of the lack of the latter in the Atlas rigs. If one wants to add a monitor and use a hand key, the circuit of Fig. 3 is very suitable. The circuit is actually rf powered, although this is not obvious since pin 8, via the 10k pot, is actually connected to an rf rectified voltage point of the swr bridge built into the transceiver for swr protection of the output stages. Both volume and tone of the CW monitor are adjustable. These controls can be PC board types, adjusted once and left alone, or they can be brought out as back panel controls.

Finally, for enjoyable CW, one does have to add more selectivity. Abundant active audio filters have been described to suit the purpose and so this point won't be belabored. Fig. 4 shows one very suitable low cost active audio filter which peaks about 750 Hz. It can be connected in the Atlas audio chain by breaking the leads before the af gain control or used as a separate circuit only when headphones are plugged in. There are enough contact possibilities on the headphone jack to arrange this. Used this way, the problem of providing an in/out switch for the peaking filter is avoided. As with almost any active audio filter, the key to obtaining the best performance from it is not to overload it. Driving it too hard will considerably broaden its selectivity peak and produce a "mushy" output.

Those using Atlas rigs with some of the earlier Atlas ac power supplies have noted a disturbing dimming of the panel lamps during modulation. Atlas has produced a power supply modification which takes care of this problem. Fig. 5 highlights the modifications necessary to improve the power supply regulation so no dimming is apparent. The diagram also shows the complete power supply diagram, in case one wishes to try to duplicate the circuit. A neat construction procedure is used in case of the 1N3491R diodes which form the full wave rectifier for the "high amp" (transmitter) power supply line. These diodes have their anode as a screw stud so they can be bolted *directly* to the chassis of the power supply to form a heat sink for the diodes. The simple 1N4005 diodes handle only the approximate 500 mA load of the transceiver when in the receive mode and require no special care. ■

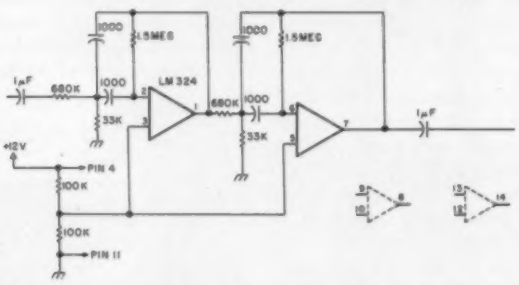


Fig. 4. Audio peaking filter for CW to be installed before the AF gain control or in the headphone lead. Note the two stages are the same. The IC contains two unused amplifiers (dotted lines) and these can be used also for a somewhat sharper filter. The 1 mF coupling capacitors are needed only for in/out coupling, not between the stages.

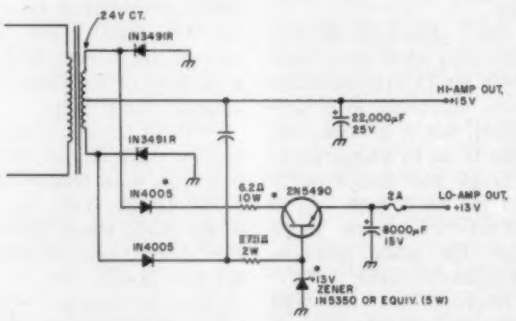


Fig. 5. Diagram of the Atlas ac power supply. The three components marked with an asterisk can be added to earlier model power supplies to improve regulation and eliminate dial lamp blinking during modulation. Home brewers can duplicate the supply if a good 24 volt center-tapped transformer can be found that will deliver 8-10 Amperes continuously.

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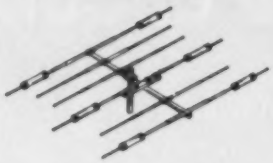


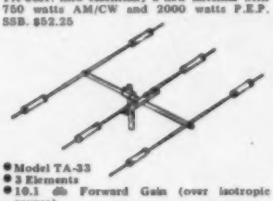
TRAP MASTER 36 . . . 10, 15 & 20 Meters

- Model TA-36
- 6 Elements
- Forward Gain (over isotropic source) - 10.1 db on 15 & 20 meters, 11.1 db on 10 meters.

Front-to-Back Ratio on all bands. 20 db.
This wide-spaced, six element configuration employs 4 operating elements on 10 meters, 3 operating elements on 15 meters, and 3 operating elements on 20 meters. Automatic bandswitching is accomplished through Mosley exclusively designed high impedance parallel resonant "Trap Circuit." The TA-36 is designed for 1000 watts AM/CW or 2000 watts P.E.P. SSB. Traps are weather and dirt proof, offering frequency stability under all weather conditions. $335.25

MOSLEY AK-60 MAST PLATE ADAPTER
Mast Plate Adapter for adapting your Mosley 1½" mounted beam to fit 2" OD mast. Complete with angle and hardware. $11.15

TA-33JR. POWER CONVERSION KIT MODEL MPK-3
Owners of the Mosley Trap-Master TA-33Jr. may obtain higher power without buying an entirely new antenna. The addition of the MPK-3 (power conversion kit) converts the TA-33Jr. into essentially a new antenna with 750 watts AM/CW and 2000 watts P.E.P. SSB. $52.25



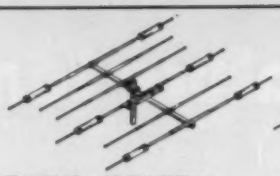
- Model TA-33
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

The Mosley TA-33, 3-element beam provides outstanding 10, 15 and 20 meter performance. Exceptionally broadband — gives excellent results over full Ham bandwidth. Incorporating Mosley Famous Trap-Master traps. Power Rating — 2KW P.E.P. SSB. The TA-33 may also be used on 40 meters with TA-40KR conversion. Complete with hardware. $288.50

MULTI-BAND BEAMS
TRAP MASTER 33 . . . 10, 15 & 20 Meters

- Model TA-33Jr.
- 3 Elements
- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

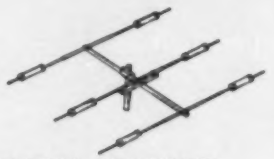
The TA-33Jr . . . incorporates Mosley Trap-Master Junior traps. This is the low power brother of the TA-33. Power Rating — 1 KW P.E.P. SSB. $151.85



CLASSIC-36 . . . 10, 15 & 20 Meters
Model CL-36

- 6 Elements
- 10.1 db Forward Gain (over isotropic source) on 15 & 20 meters, 11.1 db on 10 meters.
- 20 db Front-to-Back Ratio on all bands.

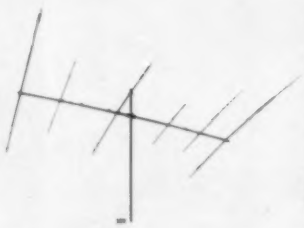
The Classic 36, like the smaller Classic 33, incorporates both the Mosley World-Famous Trap-Master Traps and the Mosley Classic Feed-System. Designed to operate on 10, 15 & 20 meters, this multi-band beam Model CL-36, employs the high standards of quality construction found in all Mosley products. The boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" system has a feed point impedance of 52 ohms at resonance. Wind Load — 210.1 lbs. at 80 MPH. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Approx. shipping weight — 71 lbs. via truck. $310.65



CLASSIC-33 . . . 10, 15 & 20 Meters
Model CL-33

- 3 Elements
- 10.1 db Forward Gain (over isotropic source) on all bands.
- 20 db Front-to-Back Ratio on 15 & 20 meters, 15 db on 10 meters.

BRIDGING THE GAP . . . The Classic 33, combines the best of two Mosley systems. Incorporating Mosley Classic Feed System for a "Balanced Capacitive Matching" system with a feed point impedance of 52 ohms at resonance, and the Famous Mosley Trap-Master Traps for "weather-proof" traps with resonant frequency stability. This extra sturdy multi-band beam, Model CL-33, for operation on 10, 15 & 20 meters features improved boom to element clamping, stainless steel hardware, balanced radiation and a longer boom for even wider element spacing. Power Rating — 2 KW P.E.P. SSB. Recommended mast size — 2" OD. Wind Load — 120 lbs. at 80 MPH. Approx. shipping weight — 45 lbs. $232.50



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CLASSIC-203 . . . 20 Meters
Model CL-203
3 Elements

- 10.1 db Forward Gain (over isotropic source)
- 20 db Front-to-Back Ratio

Incorporating the Mosley patented Classic Feed System, this full size 20 meter single-band beam has 1½" to 3/8" dia. "swaged" elements wide spaced on a 2" dia. 24' boom. Maximum element length-37' 8½". The high standards in quality construction established by Mosley in over a quarter-century of manufacturing is reflected in this mono-band . . . Model CL-203. Boom-to-mast clamping assures stability with a time-tested arrangement of mast plate, cast aluminum clamping blocks and stainless steel U-bolts. The exclusive "Balanced Capacitive Matching" System has a nominal feed point impedance of 52 Ohms at 2 KW P.E.P. SSB. Recommended mast size-2" O.D. Approx. shipping wt: 42 lbs. via truck. $227.65

40 METER CONVERSION KIT MODEL TA-40KR
Work 40 meters in addition to 10, 15 & 20 meters by using a TA-40KR conversion kit on the radiator element of the TA-33 and TA-36. (Beams with broad band capacitive matching may not be converted!) Convert the TA-33Jr. with the MPK-3 (power conversion kit) before adding the TA-40KR kit. $92.25

SIGNAL-MASTER ANTENNA
Beam Antenna . . . Model S-402 for 40 meters
For a top signal needed to push through forty meter QRM, the Mosley Signal Master S-402 will do the trick! This 100% rust-proof 2-element beauty constructed of rugged heavy-wall aluminum is designed and engineered to provide the performance you need for both DX hunting and relaxing in a QRM free rag-chewing session. Beam is fed through link coupling, resulting in an excellent match over the entire bandwidth. $267.50

Super
3-Element Thunderbird
for 10, 15 and 20 Meters
Model TH3Mk3 — $199.95

Hy-Gain's Super 3-element Thunderbird delivers outstanding performance on 10, 15 and 20 meters. The TH3Mk3 features separate and matched Hy-Q traps for each band, and feeds with 52 ohm coax. Hy-Gain Beta Match presents tapered impedance for most efficient 3 band matching, and provides DC ground to eliminate precipitation static. The TH3Mk3 delivers maximum F/B ratio, and SWR less than 1.5:1 at resonance on all bands. Its mechanically superior construction features taper swaged slotted tubing for easy adjustment and larger diameter. Comes equipped with heavy tiltable boom-to-mast clamp. Hy-Gain ferrite balun BN-86 is recommended for use with the TH3Mk3.

	THREE3	THREE
Electrical		
Gain—average	8.7dB	8dB
Front-to-back ratio	25dB	25dB
SWR (at resonance)	Less than 1.5:1	Less than 1.5:1
Impedance	50 ohms	50 ohms
Power rating	Max legal	Max legal
Mechanical		
Longest element	31.1'	27'
Boom length	24'	14'
Turning radius	20'	15.7'
Wind load at 80 MPH	156 lbs.	103.2 lbs.
Maximum wind survival	100 MPH	100 MPH
Net weight	57 lbs.	36 lbs.
Mast diameter accepted	1¼" to 2½"	1¼" to 2½"
Surface area	6.1 sq. ft.	4.03 sq. ft.

6-Element Super Thunderbird DX for 10, 15 and 20 Meters Model TH6 DXX $249.95 Separate HY-Q traps, featuring large diameter coils that develop an exceptionally favorable L/C ratio and very high Q, provide peak performance on each band whether working phone or CW. Exclusive Hy-Gain beta match, factory pretuned, insures maximum gain and F/B ratio without compromise. The TH6DXX feeds with 52 ohm coaxial cable and delivers less than 1.5:1 SWR on all bands. Mechanically superior construction features taper swaged, slotted tubing for easy adjustment and readjustment, and for larger diameter and less wind loading. Full circumference compression clamps replace self-tapping sheet metal screws. Includes large diameter, heavy gauge aluminum boom, heavy cast aluminum boom-to-mast clamp, and heavy gauge machine formed element-to-boom brackets. Hy-Gain's ferrite balun BN-86 is recommended for use with the TH6DXX.

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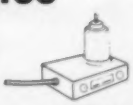

MM-JM-150 for 144 MHz use
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PC Layout Tips

- - next time, do it right !

Many easy methods for printed circuit board fabrication have been published before, but most of them are limited in that only simple boards can be produced with them. In these days of IC keyers, IC frequency counters, etc., this is rather undesirable.

I recently ran up against this problem when building the K2BLA keyer (*73 Magazine*, December, 1973). Not possessing a drill press or the fancy photographic equipment that seemed to be necessary for construction of a PC board accommodating ICs, I came up with another method using neither. It will produce a PC board with a minimum of effort.

Assuming that no circuit board plan or template is available, one can be made in the following manner: Lay a sheet of paper on a flat piece of styrofoam or similar material. Now, using actual components, stick them into the styrofoam as they will appear on the finished circuit board and draw connecting lines and pads on the paper. Because of the nature of the styrofoam, components can be shifted and rearranged until a pleasing template is obtained. Here are a few general hints that should help when doing this:

1. Remember that circuit diagrams don't always show Vcc and ground connections for ICs; these must be included on the board for the device to function.

2. Try to bring all outside connections to one side of the board – this looks neater and is easier to work with.

3. A list of interconnections between ICs often helps to place these parts.

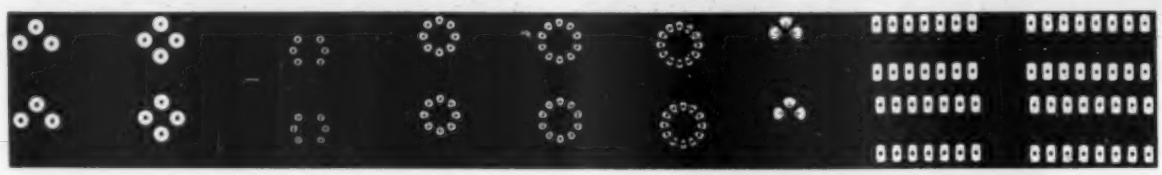
Once the circuit board template is finished, remember that it was made for the component side of the board and is the reverse of the foil side. To get the foil side template, first lay a sheet of paper on a piece of face-up carbon paper. Now lay the completed circuit board template on top of the sheet of paper and trace over the template with a pencil or blunt instrument. The reverse of the template will be transferred to the sheet of paper.

Now locate the points on the board where ICs will be located. Find a pattern that corresponds to the case style of one of the ICs. Remove it from the page (or better yet, make a copy of the page) and tape it by the edges to the place where the IC will be positioned. Now take an awl or a similar tool and position it on one of the small black dots on the pattern. Tap gently on the awl with a hammer or just press down on it until an indentation in the foil is made. Repeat this for each pad on the pattern and then remove the pattern and drill through each indentation with a small drill bit. A #60 bit is good for this purpose.

When the above procedure has been followed for each IC, draw pads around each of the holes – a resist-ink pen will work well. Then draw the rest of the circuit on the board (or use paint, tape, or another suitable resist). Let it dry, and then etch the board.

When etching, try to keep the etchant warm or even hot. This will speed the process a great deal and can be accomplished with a double boiler arrangement (with hot water surrounding the container where the board is etched). Another way to speed etching is to continuously agitate the container.

Now get that keyer – or whatever – on the air! ■



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Radio Equipment Insurance

- - foil the Hamburglar

Proper insurance on your ham equipment can prevent painful headaches when you have a loss. Proceeds paid out on the loss of ham gear often do not represent actual replacement cost of the equipment.

As a property and casualty agent for an insurance company, I've learned a considerable amount about "proper coverage."

Until recently, most insurance companies have included losses of this type under the comprehensive portion of your auto policy. Due to tremendous losses of CB radios (mostly by theft) reported nationwide, nearly all companies are now excluding two-way communications equipment from this coverage. This is now an optional coverage which can be purchased for an additional premium on your auto policy. And this coverage applies only to equipment which is permanently installed in your vehicle. The rates will vary from state to state, but I've seen $10 per year to $500 per year, depending on the state and the company and the equipment insured.

Most homeowner's, renter's, and mobile homeowner's policies include coverage for ham gear under the personal property section of the policy. This coverage is in force when the gear is located at the insured's permanent home and can be extended, on a limited scale, to cover other locations.

Both the coverage under the auto policy and that afforded under the homeowner's, renter's, and mobile homeowner's policies are good.

But disappointment, disgust, or anger may result when you have a loss to a hamburglar or fire. Depreciation is a factor which all insurance companies use in determining loss to personal property, and this includes ham gear. In the eyes of an insurer, you have possession and use of that gear for one, two, five, or even ten years. So, when arriving at a settlement figure — the check the insurer writes you — dollars of value will be taken off the actual replacement cost of that gear. Depreciation is coupled with any deductibles which almost always apply, and the final settlement may be very disappointing as well as costly for you.

The best way to save grief is to insure your gear on an Inland Marine Floater Policy. This floater is usually attached to the homeowner's, renter's, or mobile homeowner's policy. The premium is not prohibitive, either. Again, depending on your state and your company, premiums per $100 of value may vary from as low as 25 cents per $100 of value to $2 or more.

The biggest advantages of insuring your gear on a floater are that the coverage literally floats with the equipment and depreciation is usually not a factor. As a result, the amount you are paid at loss time has already been determined. This agreed-upon amount is stated right in the policy. And the deductible clause is usually low or non-existent.

Before you run down to your local insurance agent, you should have some facts and figures to present to him. First, write down the make, model, and serial number of each piece of gear to be insured. A brief description of each piece will be required. And, of course, the fair replacement cost of each item must be included. Cancelled checks, bills of sale, or other proof of purchase and/or value will be helpful too. Finally, your agent may require photographs of the equipment to be insured. Even if he doesn't need photos, it's a good idea for you to snap photos of your equipment and file them with your policy and the list of serial numbers. These pictures need not be any more than a sharp Polaroid. Visual identity of the items is the key here.

This may seem like a lot of effort and trouble just to get insurance. But I'll guarantee you that the effort is worth it. You see, all this compilation of info, pictures, values and all has been determined ahead of time — before the loss. And the agreed-upon amounts are what you'll be paid.

With the floater policy, you have protection wherever you may haul that prized gear. It's covered at the ham shack. It's covered while installed in your vehicle. And if you haul it to a hamfest or to a vacation spot, your gear is protected.

And when you have that loss, there is no hassle about depreciation, deductibles, or any of the usual problems involved in handling this claim under standard insurance policies. For the few extra bucks you pay in premium for the floater, you can save on headache and nerve pills when the hamburglar or fire strikes your QTH. ■

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Information Management System

- - organize those articles!

Electronic hobbyists have more information available to them today than ever before: reference books, catalogues, manufacturers' data sheets, magazine articles. And the range of information is wide: stereo, ham radio, computer, CB, SWL, radio control. Even if you're into only one of these electronic hobby fields (and how many of us have only *one* interest?), keeping up with the information you need to stay current can be difficult. Unless you have a photographic memory you can't keep all this information in your head, so how do you get the most out of what you read, and how do you find this information later when you need it? I've developed a technique which may not be foolproof, but for me it is far ahead of what's in second place.

How often have you remembered a magazine article or advertisement, wishing you could recall some pertinent data from it? You can remember the magazine, perhaps even which side of the page it's on, but repeatedly leafing through its pages doesn't turn up the information. The first part of my retrieval technique handles this problem nicely.

Whenever you pick up a magazine or catalogue, be sure you have with you a "Highlighter" or "Vu-Thru" pen. These wide-tipped felt markers use a clear ink and allow you to augment a sentence or word with a colored stripe. I like yellow, but they come in a variety of colors, including blue and pink. They usually cost less than four bits.

Most of the technical publications I read get several readings, each with increasing attention to detail. The first time I'm looking for articles I want to read closely later, advertisements for new products, prices, formulas, or anything unusual or interesting. These items get a liberal swipe with the highlighter pen. This ink rarely bleeds through magazine pages and in no way hurts the future readability of the ads or articles. Highlighting just makes important information easier to retrieve – it'll leap off the page at you.

You'll also need a fine-tipped ball-point or felt-tipped pen to take notes in the margins. Have an idea on how to use an advertised product or how to customize a construction article for yourself? Jot down enough information so you'll know what you meant when you see the note again. Wayne Green talks about how *73* readers can make money with their ideas by telling others, so when you think of a way to make a construction project better, write down a few ideas in the magazine margin. You can develop the idea more fully later with no danger of losing your train of thought. Good ideas sometimes flash and are gone, never to be retrieved.

By the second time you read the publication, you have a new use for the fountain pen. Always check out the "Error" or "Feedback" or "Corrections" sections of the magazine and go back – right then – to write in the correction in the previous issue. It is important to do this even with articles you haven't read or don't see any immediate need for. The surest way to need the information you have available is to let it slip through your fingers. Remember that odd-ball capacitor you'd saved for ten years hoping to find a use for? When did you need it, finally? Why, as soon as you decided it was cluttering up your junk box and threw it away. Usually a need for the discarded item develops within 48 hours of its departure. Technical information is the same way. Keep everything as up-to-date as possible and you increase the reference value of each of your publications.

I know it is very popular these days to downgrade the value of advertising, to be distrustful of advertisers. What a narrow view. Especially in the technical fields, you usually find out as much or more about a manufacturer's product from his ad as you could from talking face-to-face with a sales person. You learn when new products are introduced, "bigger and better" than the old model; you learn how products from different manufacturers stack up with each other (assuming the advertising is honest – and most of it is); you discover a great deal about product utilization – how to put a given product to work filling your particular needs. And there are ways to gather even more information from the manufacturer, and ways to put the information you have to better use.

Again the old yellow pen comes in handy. Highlight pertinent information such as price, specifications which make a given product unique or uniquely applicable to your needs or addresses of local suppliers. Use your fountain pen for notes in the ads, too. Suppose you're looking for a new 4K memory board for your hobby computer. Everybody is offering a 4K memory board, so to help you compare specs write yourself notes alongside the ads, something like: "See page 116. 4K for $10 less."

The manufacturers themselves want to help us learn as much about their products as possible, yet many of us rarely make full use of the information services available. Most technical magazines, for example, have a reader service card bound into the back of the publication – you know, the card with all the numbers on it? Though I don't have firm figures, I imagine this service costs both the publisher and the advertiser a great deal of money. But it costs even more if we don't use it. As you peruse a magazine and see an interesting product advertised, flip to the back and circle the appropriate number. Don't send in the card until you're sure you've circled all the numbers you want, because most publishers won't process more than one card from

each reader. Even if they did, that would increase the cost of getting the information to you. We can help in a small way to keep down product cost by trying not to tax the resources of the advertisers. Don't send in for information you don't really need, and do use your highlight pen to indicate which advertisers you've asked for data so you won't mistakenly request the same information twice. This could happen if he promoted a different product in next month's issue or had a different ad in another publication. Usually if you circle a number from an ad for a 4K memory board, for example, the advertiser will send you his general catalogue or whatever he has available, in addition to the information you specifically requested. There's no need to send in multiple requests to the same company.

You'll find, too, that most manufacturers are quite helpful in answering specific queries. Write a to-the-point letter explaining where you learned about the product — why you need more information. Then list your questions one at a time and leave adequate space for the company reply. You get quick service this way, you have a record of your questions and the company's reply, and you've saved someone the trouble of writing a personal letter. While not as formal, this technique ultimately provides you and others better service by saving the advertiser or manufacturer time, and since time is money ... well, you get the idea. You may find that enclosing an SASE with your letter will speed up the reply from some companies.

Now you've got all this information carefully marked and annotated, and your mail box is filling up day by day. What are you going to do with this flood of stuff? An inexpensive filing cabinet and a stack of manila folders are what you need. If you don't already have an office of sorts set up in your ham shack or computer room, you ought to start one. Pick up a cheap cardboard, two drawer filing cabinet from Sears or your local discount store. I paid $5.95 for mine a few years ago. They are lightweight but strong, and will last for years (Sears' latest catalogue lists a two drawer steel cabinet for $19.95, if you want more permanence). One two drawer cabinet probably will last the average hobbyist a long time if he's just using it to store technical information.

Use whatever system is helpful to you, but arrange the information according to subject so you can find it later. I have folders labeled variously: "Clock circuits," "Computers, general," "Memory boards," "Specialty catalogues," "IC data sheets," "Antennas," "Receivers," "Transmitters," "Hi-Fi, stereo, general," etc. Now when you get somebody's poop sheet, give it the highlighter and fountain pen treatment (perhaps cross-referencing the data to the original ad or article that prompted your interest). Then stick it away in the appropriate folder. I usually keep a sheet of notebook paper in the folder, with subjects on it that I reference most frequently. If I learn a useful tidbit of information (a formula, a source for equipment, a building technique), I jot it down on my sheet. I don't have to remember where I saw it when I need it again; I just go to the appropriate folder and look at the latest entries on my hand-written data sheet.

Treat your catalogues the same way. Arrange them on a bookshelf according to subject, highlight portions you find most interesting, cut out and save product information from catalogues you're discarding. Many companies publish IC data sheets, circuit diagrams and the like with their catalogues. This information can be invaluable when filed so you can retrieve it — and it's free. Too, mark the date you received each catalogue near the address label. This helps you decide which catalogues are out-of-date as new ones arrive.

Use a copying machine. Many people have access to a copier at work, or you can find one at the local post office, library or other business establishment. My bank offers a copying service, giving very good quality for a modest price. Expect to pay about a nickel a page for info-only quality, and about a dime a page if you really want that circuit to be as good as the original. If you make a great many personal copies on your business machine, it is only fair to make arrangements to pay for them — probably at a reduced rate. Otherwise, you're stealing from yourself and others who work with you, raising business overhead for personal gain.

By using copies of articles and ads you can file this information away with your mail-outs while keeping the magazine or catalogue intact. There are, however, some publications which you might not keep forever. I take so many magazines that I can't possibly keep all of them on file. So, regularly I go through them and tear out ads and articles I want for reference and throw the rest of the magazine away. This cuts down on the storage problem, while giving you good access to needed information. I usually wait until the year is out, however, before making the decision to rip and file.

Many publications regularly provide instructive articles in a series ("How Do You Use ICs?", in *73*, for example). If the subject is interesting and the articles are well done, why not make up the series into a booklet when it is completed? You can either rip out the originals or make copies. Staple the pages together with a stiff cardboard cover, use a commercial binder you can pick up in the school supply section of your grocery store or discount outlet, or simply put the series in a manila folder and label it. You'd be surprised how useful it can be to have the whole series together so that you can reference it like a book when you need the information. A note on copying: If you think you might want to copy something, don't highlight it first. The highlighted portion sometimes copies dark and is hard to read. So copy the material first and highlight it as you re-read. Of course, you can make your margin notes before copying if you don't use a red pen. Most copiers don't do a very good job of copying red ink.

Another excellent information retrieval aid is the year-end listing of articles provided by many magazines like *73*. Usually published in the last issue of the year, these listings are well cross-referenced and are a great help in finding just what you need for that next project. Again, I find a copy machine helpful. Copy the list, then cut it up according to subject and file the listings with the appropriate material in your filing cabinet. You may not have copied the full article the first time around, but having the cross-indexed reference on file can be almost as good. Alternately, you can hand copy the most interesting references on your notebook paper sheet in each file. If you know enough about your individual needs, you can transfer in a reasonable time all you're likely to want.

One more thing. Keep a card file, 3" x 5" or 4" x 5", depending on your needs. Have you ever spent a long time researching a subject, finally found just the right source, wrote off for the information, and then lost the address? When your query is lost in the mail or in the paper shuffle at its destination, you might have to start all over again with your original research. So keep a

file card copy of what you learned the first time and there won't be a second time.

Long distance telephoning is easy and relatively inexpensive these days, and some of us tend to use it to get technical aid with a specific product. When you have talked directly with someone at a given company, be sure to find out the name of the individual who helped and make a note of the type of information provided, the department in which the person works, the telephone number and the department extension. File away this information on two cards: one with the company name and another under the subject involved (memory boards, to continue our example).

Sound like a lot of work? For someone who isn't used to getting things organized it might, but once the ground work is laid it's easy. Once you get the system operational – i.e., when you've purchased a filing cabinet and manila folders, when you have the yellow (or blue or pink) marker in hand – then the system mostly takes care of itself. You'll likely start out simply, with large subject designations in your files. But as you get more information you'll do away with such general labels as "Computers" in favor of folders marked: "Computers, mainframes," "Computers, memory," "Computers, interface," "Computers, power supplies," and so forth.

You'll soon wonder how you built even a simple code practice oscillator without first researching available circuits from your file cabinet memory. But if you're an addicted saver and organizer like me, you'll have to learn, too, how periodically to sort through your bulging files and tearfully toss out a few sheets you haven't used in a long time – and won't need, until you see the trash man driving with them down the street. ■

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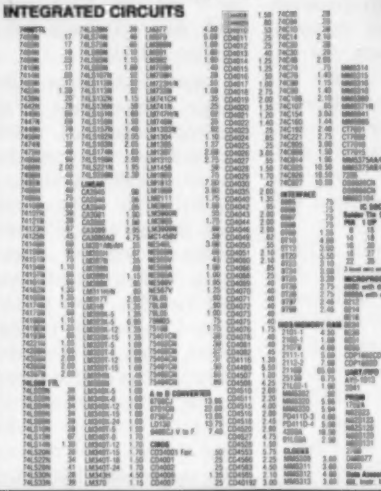

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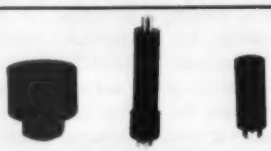

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CW Keycoder Improvements

-- visual space indicator

The CW Keycoder 1 authored by WA9VGS in the July, 1976 issue of *73* was excellent. However, there are a couple of modifications that I myself incorporated, and made the project very pleasing. References will be made several times to the above article.

When I went parts searching, I found that the SCR described as a 2N889 or equivalent was hard to find. In fact, in looking through some old catalogs (Deeco, Cedar Rapids IA), they indicated a price of $38.00 each. That, of course, was back in 1968. Recent prices of around $16.00 proved to me that there must be another SCR that would work without putting a dent in my billfold.

Sylvania's ECG 5404 did the trick. There are changes in the circuit, but nothing drastic. See Fig. 1.

Another problem that I encountered was the type of keyboard that I purchased at a flea market. This keyboard was built for National Cash Register by Sanders Associates, Inc. My experience was that only some of the characters would activate the SCR. This had me going for quite some time as all the switches checked out ohmically perfect. Keys that wouldn't function were like the "M" and "N", but "A", "B", "0" would work. In tearing down those that wouldn't work, I found absolutely no difference electrically or mechanically. After a few tests, I found that increasing the cathode current of the SCR helped, but other problems arose. This was not the solution. I finally realized that the particular keys which didn't work also had upper case functions. These glass enclosed reed switches had a different propagation time element. My only solution to this problem was to exchange these switches with extra keys that I wouldn't be using, such as "INSERT FORMAT," "DELETE FORMAT," "SEND BLOCK," etc. There were enough to complete the alphabet and numerals. The moral of this is to be sure of the type of keyboard that you may purchase, and know what type of switches are used.

I installed the second modification after I used the Keycoder for a while. With the speed control, you are able to control the speed of characterization, but not of the spacing between the characters. Since I use the Keycoder for teaching CW in our amateur classes at our club, it was desirable to be able to send CW at precise words per minute. To meet this requirement, I installed an NE555 timer between the 600 Ohm resistor (R7) and the gate of the SCR. In Fig. 1, you will find that when a low is present on the output of the gate IC3 pin 6, during characterization, this causes a low on the input of the timer pin 2. This starts the timer into operation and a high is then present on the output of the timer. This high turns the inverter transistor on (saturated) and, in turn, the collector voltage drops to zero. This low is applied to the gate of the SCR, which disables the keyboard. With the space adjust pot adjusted properly, the keyboard will not function until the timer has reset. Even when the high is returned to the input of the timer, after characterization, the timer has to reset before a low is presented to the base of the transistor. When this occurs, the collector voltage will go up to the power supply voltage and ready the gate of the SCR. An LED was installed in the collector circuit so a visual indication would be given as to when the keyboard was ready. When the LED is turned on, it means that the keyboard is ready for characterization.

As you can see, this enables one to be able to control the spacing of his characters visually. A calibrated dial can be placed around the space control to indicate the wpm.

Another change that I made to the Keycoder which I feel was worth the time was to install a phono jack on the panel for external keying with a telegraph key. This jack *must be insulated* from the chassis if the chassis is common to the power supply. With a 1k resistor connected between plus 5 volts and the center pin of the jack, and the outer pin connected to pin 4 of IC2 (555), this will permit keying of the sidetone generator and also the relay. With this, we are able to use this keyboard with versatility, especially when we have Novices learning to send CW. It's a beautiful instructor's aid.

I wish to thank WA9VGS for the very fine article and *73* for publishing it. I would like to also thank Hobby Industry in Council Bluffs, Iowa, for their fast parts procurement of the Amidon cores used in this project. ■

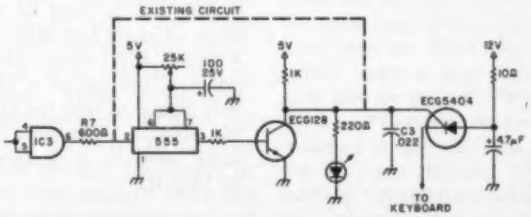


Fig. 1.

S. M. Allen K4JEM
308 Victoria Avenue
Fort Walton Beach FL 32548

Heath HW-2021 Review

-- a lot of HT for the price

Photos by Jim Gerritz WA4FMA.

When the Heath 2 meter FM HT appeared on the scene, I was in the market for an HT. Many things about the Heath interested me, not the least of which was the price. One hundred seventy dollars ($170) for a 5 channel receive, 10 channel transmit, 1 Watt HT with "rubber duckie," nicad pack and charger seemed like quite a deal -- so I ordered one.

My kit arrived and I was really impressed (and a little intimidated) by the piece of Swiss cheese referred to as a circuit board. After checking the parts, I started on construction. Two things became immediately obvious: First, Heath's warning about this kit being "for the experienced kit builder" is very true. It is very easy to make a mistake and constant checking of component installation is a necessity. Second, they make a little remark about taking "a short break after completing each half or full section" of the board. The board is a double-clad glass board with plated-through holes. The side of the board where the soldering is done is coated with some goop which is supposed to, and does, keep solder from flowing where it doesn't belong.

The board is marked into six sections. Almost all of the circuitry is on this one board. I found that one section a night was all I could handle without having a fatigue problem. I would recommend that those of us whose arms get a little shorter each year invest in one of those circular fluorescent lamps with a magnifying glass in the middle.

I had the charger, battery board, and four of the six sections done when it came to my attention that all was not as it should have been. A little investigation and a phone call to Heath showed me my problem. I had an early model with a 00 series number. A little word on the Heath series numbers. These are NOT serial numbers, but identify when the kit was manufactured. The series number is a five digit number, the first two digits of which indicate the revision number. Hence, a series number starting with 00 is an original issue. The third digit is the year of manufacture and the last two digits, the week of that year. The HW-2021 I have *now* is series number 01607 which means it is the first revision, manufactured in the seventh week of 1976.

Well, back at the workbench, Heath offered to send me all the changes in parts and instructions to make my kit up-to-date, but I was a little "gun-shy" and asked for a whole new kit, which they promptly shipped upon return of my partially built kit. The new kit had several circuit and part changes, a whole new instruction book, and three pages of changes to the new instruction book. The early kits had problems with the battery saver circuit, the diode antenna switching, and a lack of drive in the transmitter. There were also problems in the instruction manual. However, the 01 series kit corrected all these problems and my kit was assembled and aligned by the book with no problems. There were a few shortages in the parts list, but these were promptly supplied by Heath.

Circuit Description

Referring to the block diagram, you can see that the receiver is a rather conventional single conversion receiver. Diode switching is used in the antenna circuit (look Ma, no relays or multipole PTT switches). The rf amp consists of two 40673 dual gate MOFETs in common source configurations. A third 40673 is used as a mixer. Two monolithic crystal filters are used at the 10.7 MHz i-f to give a 4 pole filter response. A single bipolar transistor and an RCA CA3089 IC is used as the entire i-f chain and detector. A rather novel circuit innovation is the use of a 10.7 MHz crystal to raise the Q of the quadrature detector. The audio amp is a Motorola MC1454 IC.

The oscillator chain consists of a 15 MHz crystal

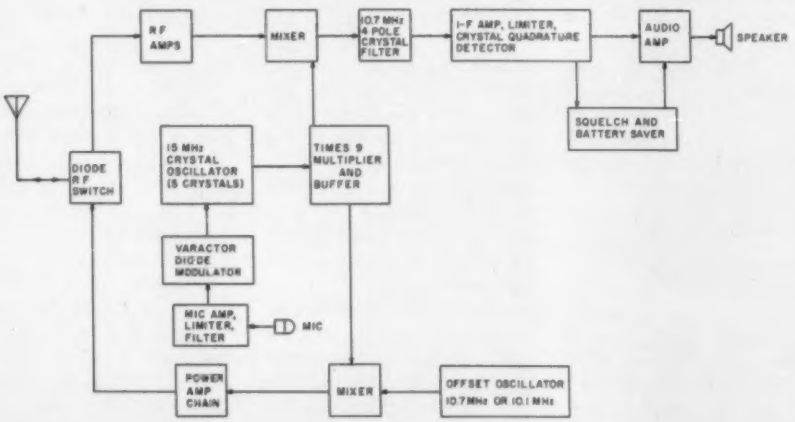


Fig. 1. HW-2021 block diagram.

oscillator followed by two triplers and a buffer. There are five diode selected crystal positions, each with its own netting capacitor. The output of the chain is 10.7 MHz below the receive frequency. The squelch and battery saver circuit is one of the unique features of this HT. As long as the receiver is squelched, there is an oscillator that runs at about 3 Hz. The output of this oscillator turns on the entire receiver for about 20 ms three times a second except for the crystal oscillator, which runs continuously. So for 313 ms out of every 333 ms, the load on the nicad pack is just the crystal oscillator plus a small load in the battery saver circuit itself. The audio amp is not controlled by the battery saver but by the squelch, and when squelched, the load is small. All this adds up to a minimal load on the nicad pack when no signal is being received.

When a signal is received (during one of those 20 ms receiver on periods), the squelch is opened, the 3 Hz oscillator disabled, and the battery saver turns on the entire receiver as long as the squelch is open. The audio amp is also enabled. The signal goes away and the battery saver resumes operation. All in all, a rather cute circuit. (Hmmm — a squelch operated 3 Hz clock oscillator and diode switched crystals. Sounds like half a scanner!) There is an LED on the front panel that flashes when the battery saver is in operation and is on solid when the squelch is open. The squelch itself is a signal amplitude operated circuit rather than the more conventional noise operated squelch.

The transmitter is less conventional. The same crystal and oscillator chain is used as is used by the receiver. There is an offset oscillator with 10.7 MHz and 10.1 MHz crystals supplied with the kit. The output of the main oscillator chain and the offset oscillator are mixed in another 40673 dual gate MOSFET to give the transmit frequency. The mixer is followed by five bipolar transistors to bring the output power up to the proper level. Note that one crystal will give one receive and two transmit channels and, once one of the transmit channels is trimmed on frequency, the receiver and the other transmit frequency are on frequency within 250 Hz. Purists could probably trim the offset crystals, but I really don't think it is necessary. With my unit there is about a 130 Hz error on one transmit frequency if the other is set on exactly. As an example, the crystal supplied with the kit is 15.1377 MHz, which gives 136.24 MHz (when multiplied by 9), the proper injection frequency for a receiver with a 10.7 MHz i-f, for 146.94 MHz. Mixing the 136.24 MHz with 10.7 gives 146.94 MHz, and with 10.1 MHz gives 146.34 MHz. So you get simplex and the -600 kHz offset for 146.94 MHz with just one crystal. Modulation is accomplished by a varactor diode across the 15 MHz crystal, driven by a mike amp, limiter, and filter consisting of a JFET and a 741 op amp. The HT has a separate microphone for the transmitter, reducing the switching requirements and giving better fidelity than if the speaker had been used as a mike.

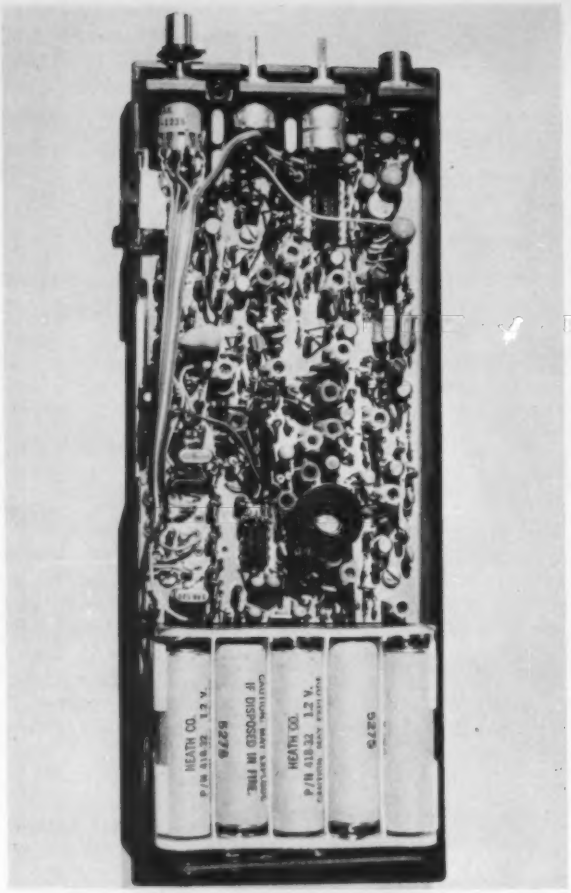
The nicad pack consists of 10 AA size, 1.2 volt, 450 mAh cells in series with a simple but effective charger. The only charger circuitry external to the HT is the transformer.

PTT is accomplished by the simple expedient of switching the nicad pack from the receiver circuit to the transmitter circuit. This is done with an SPDT microswitch under a large aluminum bar on the left side of the unit. The rubber duckie is mounted on the top right of the HT in a threaded 5/16 bushing. On the right side of the unit at the top is a standard miniature closed circuit phone jack that is used for external antenna connection. Channel selector, squelch, and volume/power controls are on top. The simplex/offset switch is on the left side of the unit above the PTT bar. The speaker is centered in the grill on the front and the mike is under the top left-hand corner of the grill. The case itself is high quality plastic, sprayed on the inside with a conductive coating. The board is mounted to the case back and the case halves fastened together using threaded inserts and machine screws. No self-tapping screws are used.

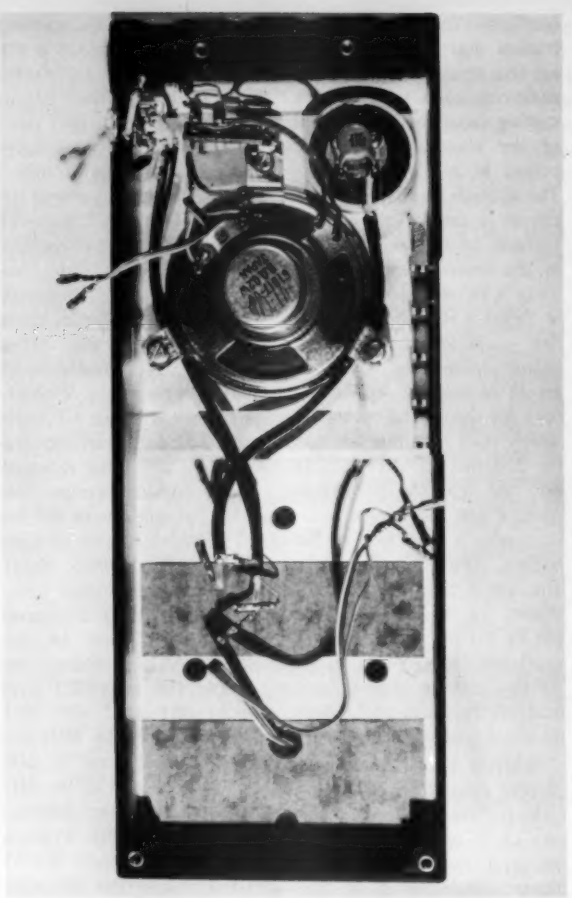
Heath HW-2021 2 meter handie-talkie with HWA-2021-3 autopatch encoder installed. Small slide switch above PTT bar on left side is the simplex/-600 kHz offset switch.

Alignment

Alignment is simple and straightforward. An rf detector and a 51 Ohm dummy load are supplied with the kit. The only test equipment needed is a VOM. The only time exotic equipment should be used is when netting the crystals, which should be done with a frequency counter, although it can be done on the air with a friend. Note: The friend can also talk to you on a repeater if direct



Inside the HW-2021. Frequency controlling crystals are on the left side about 2/3 of the way down. (146.52 crystal is in position 5. Positions 2, 3 and 4 are vacant.) Netting capacitors are just visible under the ribbon cable to the left of the crystals. The offset oscillator crystals are located between the channel switch and the squelch pot. The two crystal-looking things on the right side about 1/3 of the way from the top are the monolithic crystal filters. Note the 2-56 screw in the rubber duckie bushing at the top right — very difficult to get a screwdriver on to connect the rf cable. Transistor with heat sink is rf output.



Inside the front cover of the HW-2021. Small jack at upper left is the external antenna connection. Three wire ribbon cable coming through the bottom is from the HWA-2021-3 auto-patch encoder.

is used with the HT. No problems were encountered in alignment.

Performance

The published specs on the HW-2021 are not earth-shattering: one Watt output and receiver sensitivity of 0.5 uV SINAD or 0.75 uV for 20 dB quieting. This is across a ±1 MHz range from the alignment frequency. My unit has only been used between 146.16 MHz and 146.94 MHz, but I found the performance quite a bit better. My output power was 1½ Watts across the measured range and the sensitivity measured on a Singer FM 10 CS meter was 0.25 uV for 20 dB of quieting. The squelch operated well below 0.2 uV. The receiver is quite immune to intermod and adjacent channel rejection is adequate. I can copy the 76 machine in Pensacola, 50 miles away, while the local 79 repeater is operating. It does suffer from desensitization and plain front end overload when operating in the immediate vicinity (100 meters or so) of an off-frequency source of a few Watts. The squelch circuit leaves a little to be desired. Since it is an amplitude squelch, it is more sensitive to external conditions, such as noise levels and hand capacity, than a noise squelch. The setting of the squelch is relatively critical, there being a narrow range between keeping the squelch closed and having it open with a weak but copyable signal.

The audio output is rated at ½ Watt. There is sufficient audio to hear a station in an open car (my wife's VW Thing) at 55 mph. The audio can be run all the way open without objectionable distortion.

The transmitter has only two problems. The modulation is nonsymmetrical. My unit had an upward deviation of 7 kHz while downward was only 3.5 kHz. The other problem is the PTT sensitivity. It is, for me, much too light. Even with the optional installation to increase the pressure necessary to actuate the PTT, it is much too easy to activate the transmitter accidentally.

Opinions

I felt several improvements could have been made in the kit. I don't like using the phone jack for an rf connection. A BNC jack on top instead of the 5/16 threaded bushing with a BNC rubber duckie would eliminate the

phone jack for external rf connection and clean up some of the internal wiring. It would also allow the phone jack to be used as an external mike or earphone jack, neither of which are provided for. This is a change I am seriously considering for my unit. Also, there is no provision for operating from external power while protecting the nicad pack from possible excessive charging current. This means that all operation must be done off the nicad pack. The nicad pack snaps in place easily, but is not particularly easy to replace since the unit must be opened up and several leads disconnected to get to the pack.

The coax cable used for rf is not to my liking. It's the stuff that has foil instead of braid with a wire running down the foil. This shield wire is rather brittle. I would rather have seen a good high quality subminiature coax used.

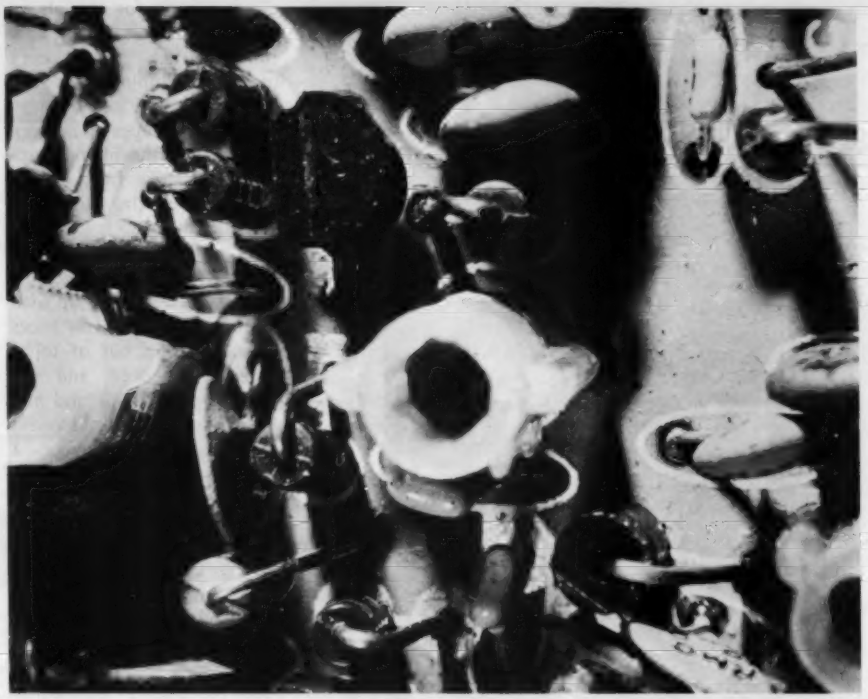
With the +600 offset activity increasing above 147 MHz, a third offset position would have been nice. As it is now, I would have to sacrifice simplex or -600 offset to get the +600 offset.

There were three areas in construction of the kit that bothered me. First, whenever I cut a cable to the specified length, it seemed that when I installed it, it could have been another ¼ inch longer to make final assembly easier. Secondly, the builder is required to build up a solder bead around a mounting hole to get proper board clearance. Why not a washer? Third, a 2-56 screw is used to attach the rf line to the rubber duckie bushing. It is quite difficult to get to this screw without bending board components this way and that, and you still have to bring the screwdriver in at an angle.

Conclusion

For 170 bucks, the kit is a bargain. It went together, aligned properly, and exceeded spec. The quality is excellent, as is the manual – the kind of equipment we have come to expect from Heath. It's a little larger than most HTs (23.5 cm x 4.8 cm x 8.3 cm) but I would not have cared to build it had it been any smaller. It is sturdy, but not indestructible. I have dropped my unit three times and it broke twice. Once one of the crystal filters broke and the other time one of my crystals broke. Maybe I shouldn't have been so cheap; I should have bought the optional carrying case.

It's not perfect, but its virtues far outweigh its deficiencies and I would highly recommend it for anyone with kit building experience.



Close-up of one section of the main board. Not a helluva lot of spare room. Note ferrite bead rf choke at bottom right.

THE HWA-2021-3

After my positive conclusions on the Heath HT, I wish I could be as positive about the matching autopatch encoder – however, I can't. It's bulky, technologically obsolete, uses some rather questionable construction techniques, and does not meet the published 1½% accuracy spec. Much better pads can be obtained for the $40 the HWA-2021-3 costs.

Circuit Description

The circuitry is rather straightforward and old-fashioned. Two NE555s are used as separate high and low group oscillators. Precision (1%) resistors are switched by a miniature 12 button keyboard to generate the proper frequencies. The charging voltage waveforms across the timing capacitors are mixed in an LM301A which also filters the waveforms to make them approximate sine waves. There is also a PNP transistor driven by the square wave output of the low tone oscillator which in turn drives an LED. A rather useless circuit that lights the LED when the low group oscillator is running.

Alignment

Alignment is simple. A trimpot for each group is set at the highest tone of each group. The other tones supposedly will then be within the ±1.5% spec. The pots are mounted on the bottom of the board with the adjustment screws *facing each*

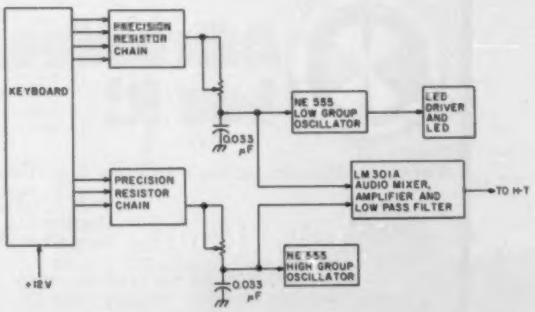
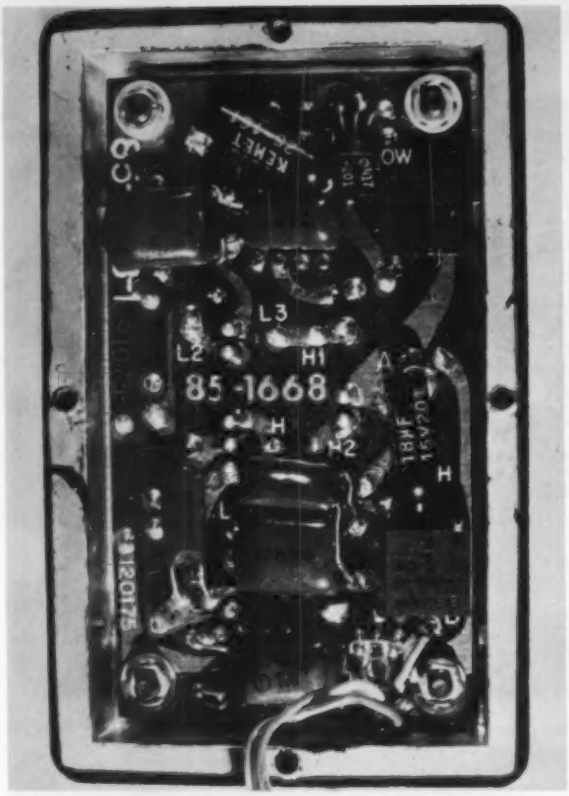


Fig. 2. HWA-2021-3 block diagram.



Rear shot of HWA-2021-3 demonstrates most of its faults. The two tubular 18 uF capacitors, one at the top and one at the right, are tack soldered in place. The ridiculous arrangement of the tone alignment trimpots at the right is obvious. The .01/.02 parallel capacitors necessary to make the whole unit work within spec are located at the top left and bottom center. The transistor at the top right drives the useless LED. Small pot at bottom right sets the output level.

other! Very difficult to adjust and impossible with the pad mounted on the HT. Had they turned the pots 90° and drilled holes in the side of the case, alignment would have been much easier.

Performance

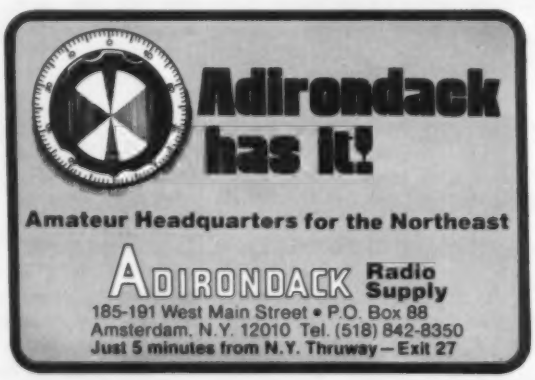
To make a long story short, it didn't meet the 1.5% spec by quite a bit. It was close enough for the phone company as long as the low tone of each group wasn't used. That eliminated 1, 2, 3, 4, 7, and *. The tone decoder on the local repeater is more critical than the phone company and since the 1 and * are used in the autopatch access sequence, I might as well have not had the pad. I tried aligning in the middle of the ranges and ended up with both the high and low tones of each group out of tolerance. I checked and rechecked the circuit and had friends recheck it and could find no assembly error. I checked the resistor chain with a Fluke 8125A digital multimeter and they were within tolerance. I tried several different 555s and .033 timing capacitors and the results were always the same. I then decided to check the design. Running the circuit values backwards through the design equations, I found that the pad was operating as expected given the components supplied with the kit. Well, I had $40 into this thing, and wanted to make it work. My options were either to change the precision resistor chains or the timing capacitors. I worked under the assumption that the resistor chains were correct (two mylar capacitors are cheaper than 7 precision resistors), and resolved the equations for new timing capacitors. Both capacitors computed out to 0.03 within 1%. I couldn't find any 0.03s, but 0.01s, and 0.02s were plentiful. So I paralleled a 0.01 and an 0.02 and substituted the pair for the 0.033s in each of the oscillators. A quick alignment by the instruction book and everything worked as advertised. Even our supercritical autopatch access decoder on WR4ABZ accepted it. I have communicated with Heath and sent them all of my lab results as well as all of my calculations. My latest correspondence from Heath reads in part: "... the chief engineer assured me that as soon as time permits, he will rerun your calculations and reply to you directly. He has also assured me that if the .03 capacitor works in your case, he sees nothing wrong with installing it ..." That letter was dated 24 June 1976.

Opinions

My pad is in use with the .03 capacitors and works well. The parts are of good quality and the manual is excellent. The board is double-clad glass with plated-through holes. However, there are two filter capacitors which are tack soldered on the back side of the board, a practice I consider poor. I have already mentioned the absurd mounting arrangement of the alignment pots and the useless LED circuit.

Conclusion

For 40 bucks, forget it! You can get a smaller, better pad cheaper. ■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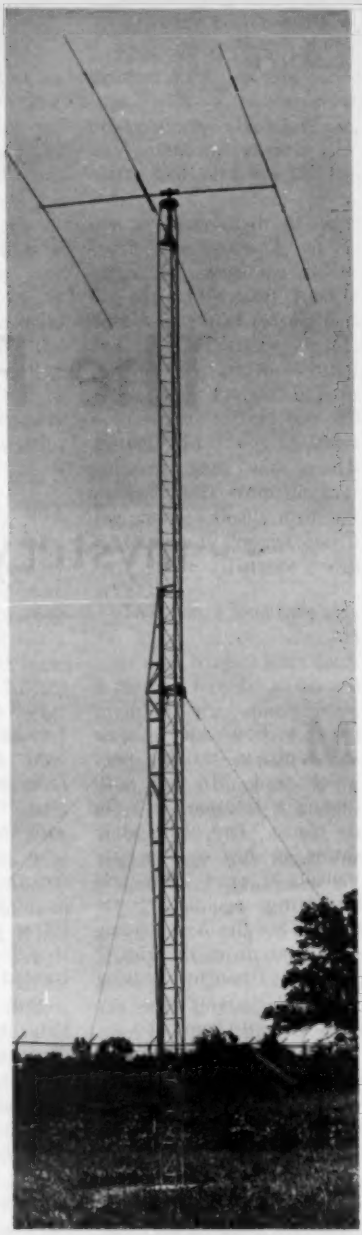
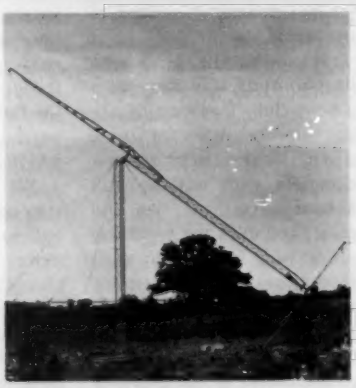




AT ROHN YOU GET THE BEST

W. Edmund Hood W2FEZ
116 W. Park St.
Albion NY 14411

The First Step

- - mystery and adventure

My boss once had a plaque on his wall which read, "To hell with finding a solution, let's fix the blame." Last night, while sitting in my own private Valhalla of wires, lights, and humming equipment, far from all but the most piercing of screams from the kids, I found my thoughts weaving backward looking for my initial step into ham radio.

I can't blame my brother for this one. He had been interested in radio a few years before, but I never cared a rap for what he liked. On the other hand, it was through him that I joined the Bunker Hill Boys Club, and that institution must take most of the blame.

If you're the kind who likes solitude, stay away from a boys club. Every major city has one or more of those diabolical institutions, complete with wall to wall kids of every shape, size, and color, and even the executive office isn't immune to visits from the diminutive membership, especially when a fight has to be settled.

Now we're getting closer to the center of the problem. I mean when we mention a fight. Sure, I'd joined the radio group at the club, but after fidgeting for a while with the code practice oscillator and watching the pattern on the screen of an old oscillograph, I'd gotten my fill of electronics — or so I thought. That was when Bob entered the picture.

Bob and I were natural for thoughts of mutual homicide. We were pretty close to the same age and on opposite sides of the nation's oldest high school rivalry. Now, giving him the benefit of the doubt (in addition to the concession of not revealing his first name which he no longer uses in public), I will say, in all fairness, that I really don't know who started it, nor did I know at the time, nor did he, but fight we did, as kids will often do, and it was a lulu.

We invited each other to step outside into the hallway, and had at it for an hour or more while Jim (he was in charge of the radio room and was the only adult to figure into all this nonsense) remained discreetly on the other side of the door. Bob was a much better scrapper than I, but I was too stupid to give in. We had at it till we both were exhausted, called a truce to rest (during which period Bob offered some constructive criticism to my lousy pugilistic techniques), and then had at it again. Bob's pointers were helpful, but not helpful enough. I still got the worst of it.

The other members of the radio group had long since gone home, and Jim, tired of sitting there by himself, called us in to cool off. I sat wearily down on one end of the bench by the code practice table, feeling very sorry for myself and hoping the world would share the sentiment. Bob, feeling brisk after his pleasant exercise, chatted for a while with Jim and then switched on the old Hallicrafters HT-9 transmitter and started calling CQ.

As I watched that very despicable person, at that moment the world's meanest bully, operating the radio station by himself, I could feel the hairs on the back of my neck bristle with resentment. I hadn't even known there was a transmitting station in that room, let alone that there was anybody able to operate one. I had heard of radio amateurs. My brother (who never exaggerated or told a lie) had said you needed a license to use one of those things. And to get that license you had to know Morse code (at least 750 words per minute) and take an exam consisting of eight million questions made up by Dr. Einstein, while the FCC examiner stood behind you with a bullwhip waiting for you to make just one little mistake. Surely such a thing was out of the question for me. Yet here was that terrible, horrible, rotten, no good, very bad person, and he'd made it.

I don't know of anybody in the amateur radio hobby that began without the assistance of another ham. But, however much help is offered from another, there is a moment when an individual has to act on his own if the thing is ever to happen. When that moment comes you often don't realize it or ponder on the possible far-reaching consequences. When I turned around in my seat, donned a pair of headphones and picked the card containing Group I of radiotelegraph code characters, I took the first halting step on a road that hasn't come to an end after 25 years. There was no thought of a license — just blind rage and a reckless vow to match anything that guy could do or die trying.

Strangely enough, the enemy proved to be a friend, although I didn't really appreciate it at the time. Half helping, half mocking, Bob kept me mad enough to keep at it. He would sit down at the key, betting that I couldn't copy whatever insult he could think to translate into dots and dashes. For the time, Jim kept an eye on the progress, but otherwise stayed out of it. Once in a while he would sit down at the key himself and give me some real practice.

The more I stuck with it, the more Bob seemed ready to encourage. Bit by bit the resentment died away to be replaced by a growing friendship. (Besides, I had reached the conclusion that, as a friend, this guy would be far less hazardous to the health.) Jim entered the scene more and more until I had the code pretty well memorized. Then he saw to it that practice continued every time I showed up. I don't know how many hours I spent there with the phones on, copying code through the din and racket that is a way of life in a boys club. But one day, out of a clear blue sky, Jim casually asked me, "When're you going up for your ticket, Willie?"

That was the first time anybody had even so much as implied that such a thing could so much as be within reach. I pondered for a moment on my brother's sadistic description of the exam, then answered, "I dunno, maybe some day if I ever get good enough at the code . . ."

"What the hell are you talking about? You only have to copy five words a minute, and you're doing better than that now!"

Well, now, this put things into an entirely different light. I pondered on Jim's remark for a while, and then timidly asked about the written exam. That, according to Jim, was nowhere near the torture session I thought it was. In fact, Jim (who by then had had a fair amount of time to estimate my learning ability) felt I could be ready for the exam in a month or so. That did it. I strode over to the calendar, pointed to a date now long since forgotten, and announced that that was when I'd go up for a ticket. I left that night feeling ten feet tall.

Back in 1951, the Novice class license was comparatively new. You had to take the exam at the FCC office. Nowadays, you can take it by mail. It was good for only a year, and after that you had to have a higher grade license or forget it.

Well, I began cramming. Jim had one of the boys in the typing class type out a copy of the questions and answers from the club's only copy of the license manual, and I was on my way. Bob, in his half-friendly, half-antagonistic way, kept prodding me on the questions until I had the answers memorized verbatim. Most of the members of the group would leave by 8:30 or so, and then Bob, Jim, and I would remain until the club was ready to close at 9:30. Sometimes we'd chat about the various operating techniques and the ins and outs of ham radio in general. Sometimes, and it was bending the rules just slightly, Jim would let me try calling an occasional CQ, which occasionally was gratified with a QSO. All in all, W1MOS (the boys club station callsign) got quite a workout.

The big day finally came. I went, completely solo, to the Customs House in Boston, feeling very adventuresome, and requested a Novice exam. The application in those days was four pages long, and it had to be notarized. Luckily, I had some change in my pocket, and the notary in a nearby bank only charged fifty cents for his service. The test itself was uneventful. Jim and Bob had done their work well. The examiner quietly announced that I'd passed and would have a license in about eight weeks.

Now, getting a license is one thing; getting on the air is quite another. This is especially so when you're fifteen years old, live in an apartment house in the inner city, and your parents are struggling to recover from financial disaster. In Massachusetts nobody will hire a kid under sixteen, and you can't earn enough money to outfit an amateur radio station delivering newspapers. However, the club was there, and I got enough operating satisfaction operating W1MOS.

Then came the end of an era. We moved from the Charlestown area, which we had universally despised, to another neighborhood considerably removed from the boys club. I was then wholly on my own to either sink or swim. Now, there was no way in sight to buy a rig, so my only alternative was to build one. Somewhere along the way I'd formed the notion that a radio amateur had to be able to build all his equipment, if necessary, without following some one else's circuit.

The public library now became my retreat. I must have read every elementary book on radio communication they had from cover to cover. I had accumulated a few junk parts and with these began experimenting. An old wood base with a tube socket mounted on it became my classroom, as circuit after circuit was tried out with no direction, rhyme or reason behind my experiments. We moved a second time and, wonder of wonders, there was an old radio in the attic with a shortwave band on it. It had no CW oscillator, but a nearby U.S. Navy station was on the air every night sending out code groups at about fifteen words a minute.

Well, after an unbelievably long time, and after two tries, I finally had my General class license, but no operating station. The attic was a saving grace here because I had a place to tinker. Jim was still available. We had countless conversations by telephone, no question being too much for him to answer. I built a receiver, and began exploring the shortwave bands myself.

That receiver, incidentally, was a sight to behold. It was built in an old wood box that the attic had coughed up, with a type 27 tube in the detector stage, a 957 acorn tube amplifier, and a 6F6 output stage. It was enough to make any engineer vomit, but I'd built it, and it worked.

For a transmitter I hatched up a two tube oscillator with a home brew power supply, which gave out an unknown number of Watts. Our yard was just big enough to squeeze in a quarter wavelength of wire (with the consent of a neighbor who let me anchor one end on his roof). I fed it with a length of twisted pair and a series tuned circuit. Had I then known what I know today, I might not have even tried to get on 80 meters. But I was blissfully ignorant and, with much patient advice from Jim over the phone, I finally made my first two-way contact over a full mile distance with W1YOR.

That was a long time ago. An awful lot of water has gone over Niagara since then. I suppose I could go on and mention the nine-year-old through whose relatives I landed my first job in the field, but I think this is the place to stop. Maybe some Novice struggling to get on the air can take heart and realize that sometimes the impossible can be accomplished if you try hard enough. Amateur radio has been good to me – it has led me into a profession that has been my bread and butter for over 20 years, and has provided an endless challenge to do the near impossible.

Jim W1MCR has long gone. Bob W1TUH lives in Connecticut, and I've only heard from him once in the past decade. But I very often find my thoughts turning to that room in the old boys club where a kindly old man, a spirited rival, and countless peoples' donations to the Community Fund all came together. I owe Jim a debt I can never repay, except possibly by steering some other smart alecky kid into the hobby. Somehow, though, I don't think I'll ever recapture that sense of mystery and adventure that accompanied my taking that first step. ■

John P. Franklin K6LUA
1074 Cheltenham Rd.
Santa Barbara CA 93105

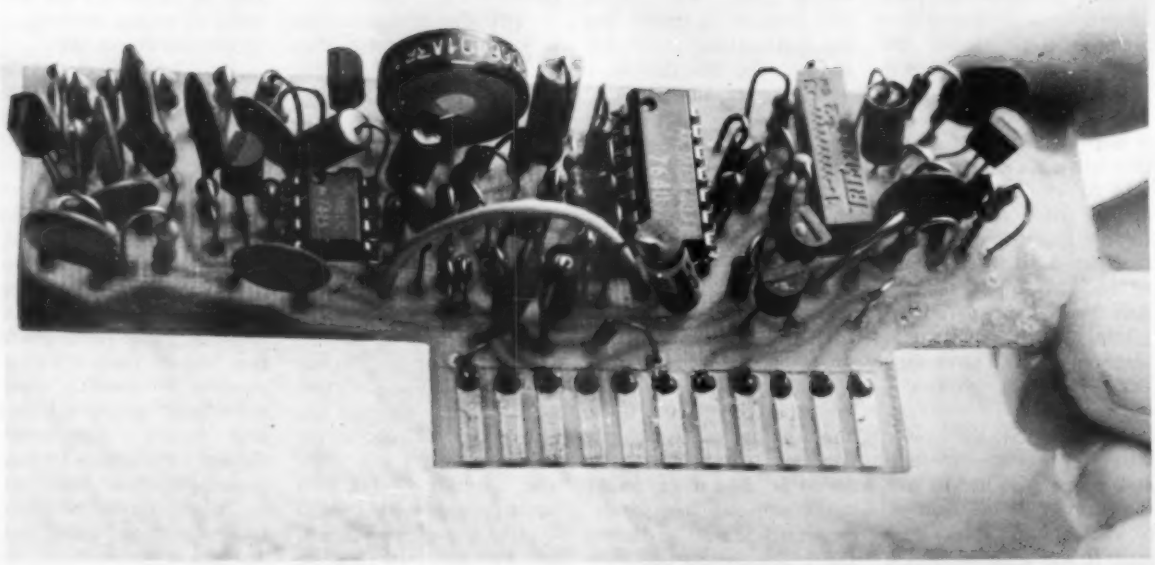
All About SCTS

-- subaudible continuous tone squelch

Subaudible continuous tone squelch has been used for years in commercial two-way radio systems to allow multiple users on a single radio channel or repeater. Most of these units use either mechanical reeds or a crystal or ceramic resonator which must be changed if a change in subaudible tone is necessary. A new resonator can cost all the way from three dollars to twenty dollars, depending on the type used.

The development of multiple op amps in one IC package has made construction of high Q active filters in a small space an easy project. A high Q active filter is the heart of this CTSS encoder-decoder.

Audio is taken from the discriminator or high side of the volume control. The high input impedance will not load the discriminator, so it is not necessary to modify the receiver circuitry. The low pass filter consisting of Q1 and Q2 passes only the audio below about 240 cycles to IC2A.



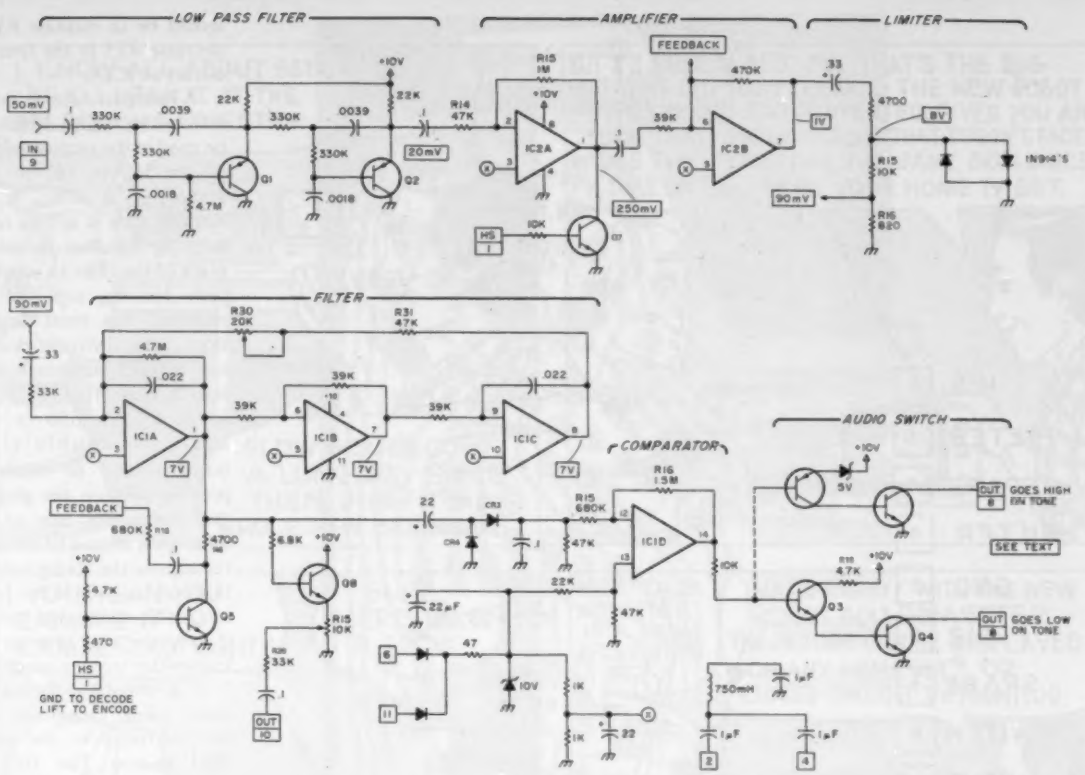


Fig. 1. All NPN – 2N3904. All PNP – 2N3906. IC1 – MC 3403 quad 741. IC2 – 1558 dual 741.

This amplifies the low frequencies and feeds amplifier IC2B, which in turn feeds a dual diode limiter. With all low frequencies being limited to .7 volts peak-to-peak, a voltage divider consisting of R15 and R16 feeds a small amount of this low frequency audio to the input of the active filter. It is most important that only enough audio be fed to the active filter so it will not limit on anything except the frequency to which it is tuned.

The active filter, which is of the "Biquad"[1] type, consists of three op amps, IC1A, IC1B and IC1C. Tuning is done using the twenty turn trimpot R30, and the course range is determined by R31. The active filter amplifies only the frequency to which it is tuned, plus or minus about one half cycle. The output of the filter is rectified by diodes CR3 and CR4. Any time the proper tone is received, the dc developed across these diodes will operate comparator IC1D. When the comparator sees sufficient voltage from the diodes it will cause Q4 to be turned on via Q3. Therefore, when the proper tone is received, the collector of Q4 will be pulled to ground. The comparator has some built-in hysteresis,[2] consisting of R15 and R16. This hysteresis will cause the transistor, Q4, to be turned on only when the output of the active filter is about six volts peak-to-peak. Once turned on, Q4 will not turn off until the output of the filter is down to about three volts peak-to-peak. This prevents the decoder from chattering on an incoming signal, thus turning the receiver audio on and off, which can be very annoying.

To cause the unit to encode, or oscillate, audio must be fed from the output of the filter back to the input. In the "mike hung up" position, Q5 is conducting hard because it is forward biased and shorts the output of R6 to ground, thus not allowing any output from the filter to be fed back to pin 6 of IC2B. Also, transistor Q7 is reverse biased, allowing incoming audio to be fed to pin 6 of IC2B. When the mike is picked up, Q7 is forward biased, shorting incoming audio to ground, and Q5 is reverse biased allowing output from the filter to reach pin 6 of IC2B. R16 is critical in value so that just the right amount of feedback will occur. This is important so the unit will oscillate on the same frequency it decodes. If IC2B is saturated too much, the frequency will be different due to the amount of time it takes the op amp to come out of saturation. The output of the active filter is also fed to transistor Q8, which serves as isolation for the audio output to the transmitter. The output level is controlled by R15, which is the emitter resistor for Q8. If the output is going to be fed into a high impedance modulator, it might be wise to increase the value of R20 so the transmitter circuit will not be loaded. Try to avoid feeding a low frequency tone such as this one into a microphone input as it is possible the microphone amplifiers will not pass such a low frequency. If possible, feed this audio directly into the modulator after the mike amplifier.

The printed circuit layout is for a Johnson 550 or 557 radio. The unit, of course, can be used with almost any radio, and has been used successfully with the General Electric Progress Line 450 units, GE Master and the new Johnson 558. When used on the 558, it is necessary to reverse the operation of the decoder as the 558 requires the ground to be released on incoming tone to unmute the receiver, whereas the 557 requires a ground to be made. This is easily done by substituting a five volt zener diode for R10, and using a 2N3906

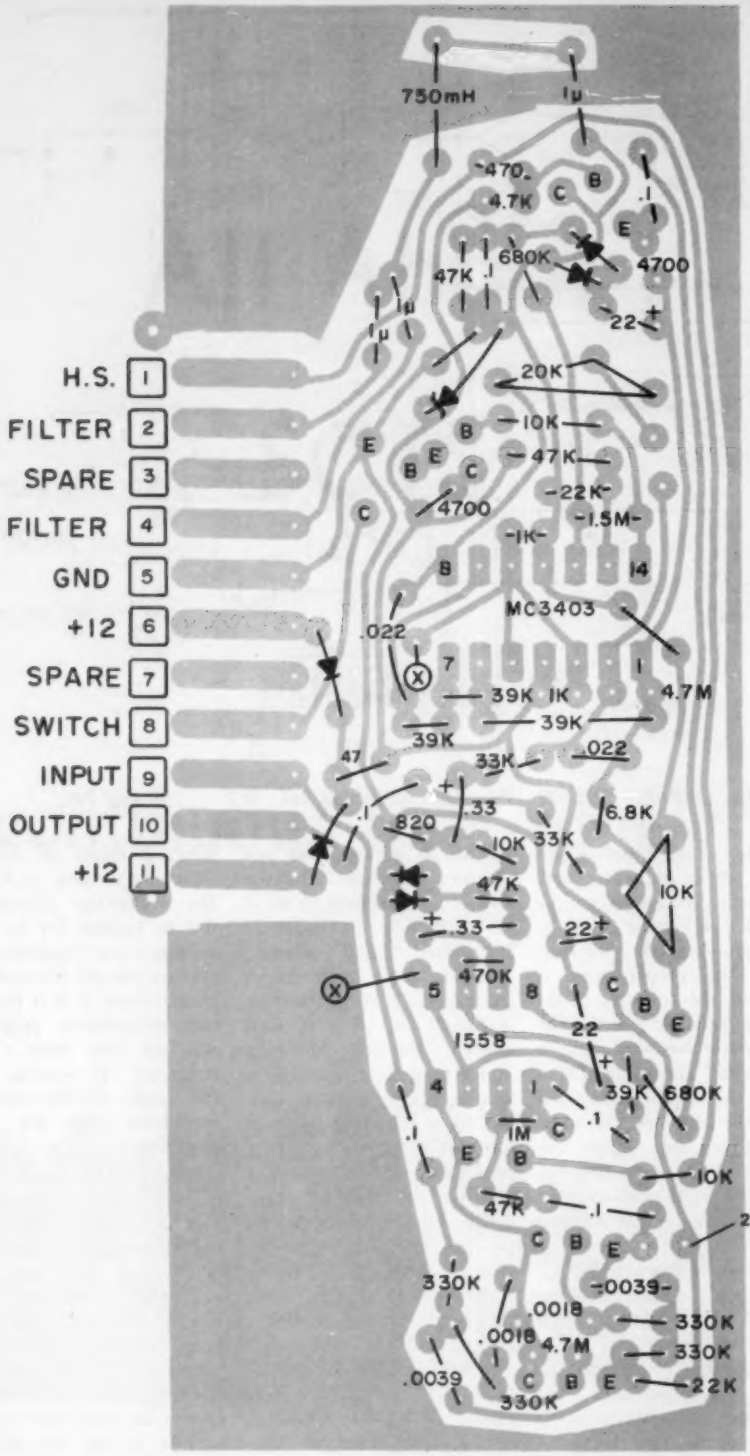


Fig. 2. PC layout.

in place of Q3. Also, when using the unit with a high input level, such as on the 558, it is sometimes necessary to put a resistor in series with the input. Depending on the peak-to-peak level of the input audio, the resistor value can be determined by experimentation. On the 558, a good value would be about 1 megohm. An alternative would be to increase R14 or decrease R15 in the feedback circuit of IC2A.

A low pass filter is included on the layout which can be used in the receiver section of the 550 or 557 to filter audio. If a filter is not wanted, then it will be necessary to install a jumper in place of the filter to provide a path for the audio in the receiver. For most applications, the encoder-decoder can be built on a single-sided board, but if it is to be installed in a 550 or 557, then a double-sided board should be made to provide pins on the plug on the component side of the unit. Wires should be soldered through as the spring connections on the plug in the Johnson won't make good contact if only the plug pins on the transmitter side are used.

It is important to use the most stable capacitors that can be found in the active filter section. The .022 uF capacitors used in this unit are Cornell Dubilier WMF1S22. The same precaution should be observed with the resistors in the active filter section. If the unit is to be used to lock up a repeater, it might be wise to increase R16 somewhat to decrease the Q of the filter so it can be activated by encoders that may be slightly off frequency. A number of these units have been constructed and are presently in use in some commercial radio systems, and they have performed quite well. There are many uses for this unit other than locking up radios. The active filter itself can be very handy for picking tones out of noise. The unit makes a stable single tone oscillator, and, by changing the capacitor values, the frequency range of the unit can be increased greatly. The low pass filter can also be used separately, as can the limiter. ■

References

[1] *Active Filter Cookbook*, Don Lancaster.

[2] *IC Op Amp Cookbook*, Walter Jung.

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SLOW SCAN'S COME A LONG WAY SINCE THEN, JIM. IT'S A WHOLE NEW BALLGAME.
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R9

Robert J. Souza WA1MXV
46 Fielding Street
New Bedford MA 02745

Rotary Autopatch Dialer

-- interface repeaters and old phones

Many repeaters use touchtone* pads for control functions and autopatch dialing. Some telephone exchanges, however, still use the rotary dialing technique. With rotary dialing, the telephone circuit is broken a number of times corresponding to the number being dialed by a mechanical switch in the telephone dial. If you dial a "4", for example, the circuit is broken four times. Fig. 1 shows the timing involved in dialing a phone number. The advent of touchtone dialing makes the rotary system a bit archaic, but it is sure to be with us for some time to come, especially in the more rural areas.

To remain compatible with touchtone-oriented systems, repeaters in areas where touchtone dialing is not available may convert the incoming tone pairs to a series of pulses in order to dial the autopatch. To be convenient, the converter should be fully automatic; that is, the mobile operator should be able to access the patch, dial the number (as fast as he or she wishes), and make the call without having to go through any special procedures just because a touchtone-to-rotary conversion is involved.

The design of a *good* touchtone-to-rotary converter can be quite time-consuming. The dialer should begin dialing as soon as the first digit is entered. Since the operator can punch in the digits much faster than the rotary system can dial them, some type of FIFO, or First-In, First-Out memory must be included. The decoded tones must be stable and glitchfree before being presented to the dialer, or a misdial will occur. The point here is that designing the thing can get somewhat messy, if not expensive. A commercial touchtone-to-rotary decoder sells for about $200.

Recently, Motorola announced the MC14409 binary-to-phone pulse converter subsystem shown in Fig. 2. This chip is part of a two-chip system which is designed to replace a telephone dial with a touchtone-like keyboard. This chip is just what the doctor ordered for a rotary autopatch. The one CMOS integrated circuit will accept a four-bit BCD number and convert it to dial pulses compatible with the Bell System. The 14409 has its own onboard clock and will dial up to a 16-digit number. The numbers may be input at rates over 1000 digits/sec.

I got one of these chips as soon as I heard about it, and breadboarded the circuit shown in Fig. 3. The circuit has the following features:

1) Only 9 ICs excluding the PLL tone decoders;

2) Access patch with * for one second, clear with # for one second;

3) Automatic timeout and hangup if patch left on for more than five minutes;

4) Will take touchtone input as fast as any human can punch it in.

Circuit Description

Since this is not meant to be a construction article, the PLL tone decoder circuit is not shown. Two very good articles on touchtone decoders have appeared recently, and those who are interested may refer to them.[1,2]

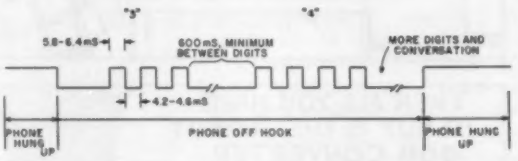

Fig. 1. Rotary dial system timing.

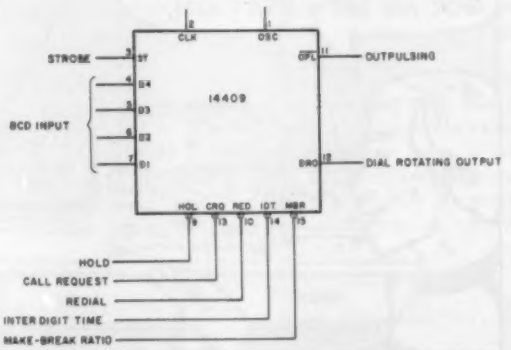

Fig. 2. MC14409 binary-to-phone pulse converter.

*AT&T trademark.

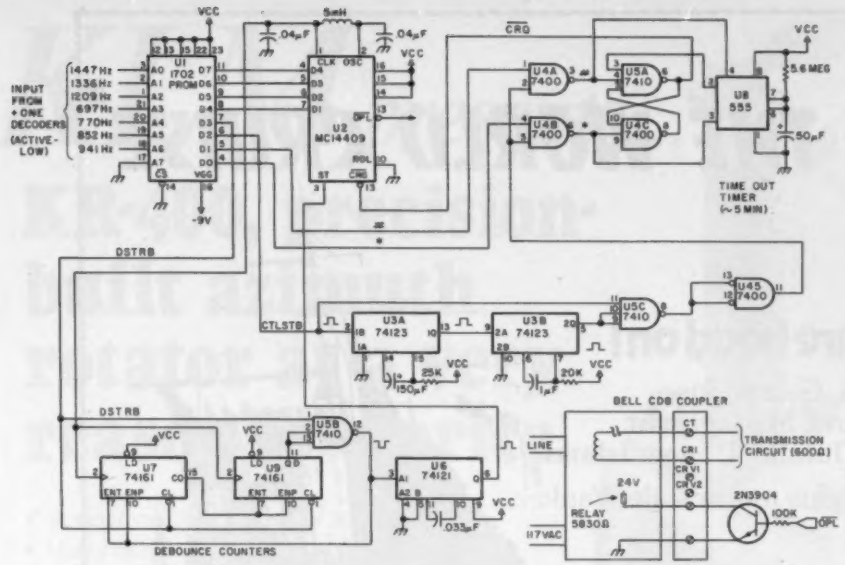

Fig. 3. Rotary autopatch. U4, U5, U6: Vcc = pin 14, gnd = pin 7. U2, U3, U7, U9: Vcc = pin 16, gnd = pin 8.

I decided to use a 1702A erasable PROM to encode the PLL outputs. Although this was a bit more expensive, I did it for two reasons – the 1702A and programmer were available, and it eliminated three or four ICs. In my opinion, every IC eliminated from a circuit eliminates 14 or 16 chances for a wiring error. Fig. 4 shows the data I programmed into the ROM. Data bits D7-D4 form the BCD output to the 14409 dialer chip. Bit D3 is the data strobe, DSTRB. It is high when any of the bits D7-D4 are high, so actually it's the logical OR of these bits. This is an example of the implementation of a bit of combinational logic (gating) with firmware (a PROM program). Bit D1 is the touchtone # and D0 is the *. Bit D2 is the control strobe, CTLSTB, the logical OR of bits 0 and 1.

The patch works like this: When a touchtone * is input (1209 and 941 Hz), PROM bit D0 and CTLSTB both go high. The 0-1 transition of CTLSTB fires one-shot U3A. After about one second, U3B fires. If CTLSTB is still present, gates U4A and U4B are enabled. Pin 6 of U6A goes low, bringing dialer chip input CRQ (call request) low. Output OPL goes high, effectively "taking the phone off the hook." The 555 timeout timer is also triggered at this time. Note that if CTLSTB doesn't remain high for at least one second, none of the above will happen and the patch will remain in the standby mode.

After the patch has been accessed and the operator hears a dial tone, he or she begins punching in the digits. Say, for example, a "7" is dialed. This causes PROM outputs D6, D5, D4 and DSTRB to go high. Whenever DSTRB is high, the debounce counters U6 and U7 begin to count. They are driven by the 16 kHz clock output of the MC14409. If at any time DSTRB goes low, the counters are cleared. This would happen, for example, if the decoders glitched on a noise spike. When DSTRB goes high and remains high, the counters count up to a count of 128, corresponding to a time interval of about 4 ms. When the count of 128 is reached, U5B and U6 generate a strobe signal to the MC14409, which causes it to input the data present in its input data lines and begin dialing. The counters are disabled on the clock pulse after the strobe is generated. (The 74161s have an *asynchronous* clear, but the enable inputs are *synchronous*. This means that if the CLR input is brought low, the outputs go to 0000 *immediately*, but disabling the counter by bringing ENT and ENP low does not halt the count until the *next* clock pulse.)

What this all boils down to is that the two counters debounce the data from the PROM and require it to be stable for 4 ms before strobing it into the dialer chip.

After the call is completed, the operator presses # to clear the patch. It, too, must be held for one second. If the mobile op is long-winded or the patch gets hung up somehow, the 555 timeout timer will hang up the patch after about five minutes by clearing the latch formed by U5A and U4C.

Doing It Legit

The dialer may be legally installed at the repeater by having the telephone company install a Bell type CD8 coupler at the repeater site. The dialer connects to the CD8 as shown in Fig. 3. A conventional audio hybrid phone patch connects to the terminals marked "transmission circuit."

I would certainly be interested in hearing from anyone who has or builds an MC14409-based rotary dialer. Best of luck with this slick chip! ■

References

1 C.W. Andreasen WA6JMM, "Autocall '76," *73 Magazine*, June, 1976, p. 52.

2 J.H. Everhart WA3VXH, "Toward A More Perfect Touch-tone Decoder," *73 Magazine*, November, 1976, P. 178.

Address	Data	Touchtone Digit
00111101	00001000	0
01110011	00011000	1
01110101	00101000	2
01110110	00111000	3
01101011	01001000	4
01101101	01011000	5
01101110	01101000	6
01011011	01111000	7
01011101	10001000	8
01011110	10011000	9
00111011	00000101	*
00111110	00000110	#

A7	grounded	D7	BCD 8
A6	941 Hz	D6	BCD 4
A5	852 Hz	D5	BCD 2
A4	770 Hz	D4	BCD 1
A3	697 Hz	D3	DSTRB
A2	1209 Hz	D2	CTLSTB
A1	1336 Hz	D1	#
A0	1447	D0	*

Fig. 4. ROM program (data in all addresses not shown is 00000000).

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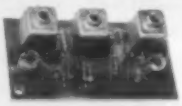

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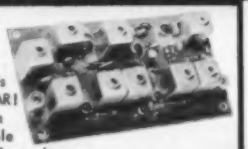

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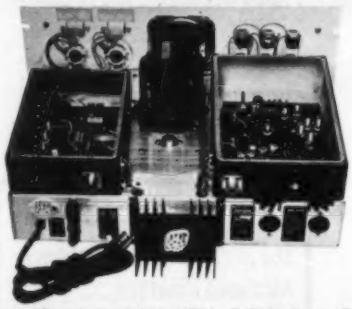

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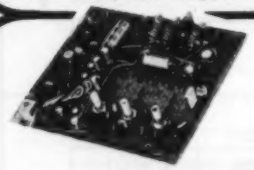

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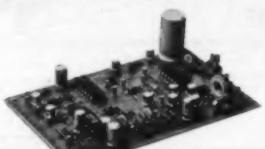

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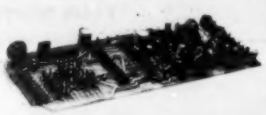

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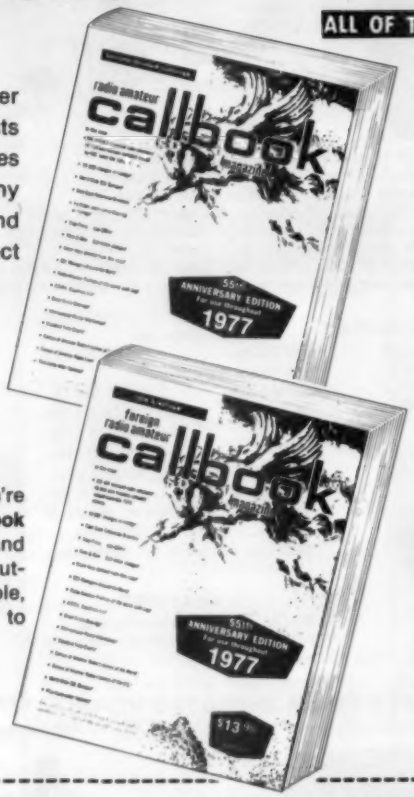

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WE PAY SHIPPING via UPS or best way on all advertised items to 50 states and APO/FPO on mailable items. Export orders shipping extra. We accept Master Charge, NC residents add 4% sales tax. Phone Bill Slep (704) 524-7519.

THIS AD MENTIONS ONLY A FEW OF THE THOUSAN'S OF BARGAIN ITEMS AVAILABLE FROM THE GIANT B&F CATALOG. CIRCLE THE READER SERVICE CARD FOR OUR CATALOG!

TELEPHONE ORDERS WELCOME! CREDIT CARDS ACCEPTED - MASTER CHARGE, BANK AMERICARD AND AMERICAN EXPRESS CARDS WELCOME! CALL US (617) 531-5774 / 532-2323 CIRCLE THE READER SERVICE CARD FOR OUR CATALOG!

B&L HELIUM-NEON GAS LASER POWER SUPPLY

Complete laser power supply, including case, coil, and enough room to mount a laser tube. We have tried it with a Hughes laser tube and it fits easily. This supply should power any 1mW helium-neon gas laser, like those manufactured by B&L, Metrologics, etc. Brand new, boxed.
Sh. Wt. 12 Lbs. . . . 5Z00178 . . . $15.00
8 for $100.00 . . . 5Z00178 . . . $100.00/8

TV to MONITOR INTERFACE KIT

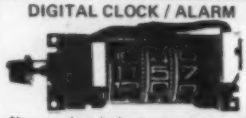
TV game board allows interface of any TV as a video monitor for computer use. With power supply & data for 300/75 ohm. Home brew money-saver! 3 Lbs.
7ZU70213 . . . $5.00 ea. . . . $27.88 for 5

COLOR TV CHASSIS

TS-951 & TS-953

We have found some 2,000 TV chassis that were damaged enroute to mfr. They were intended for use in late model sets, and are all solid state. Most have cracked PC boards or bent frames, etc. Parts alone are worth 5 times as much as our low prices. All units are sold "AS IS", all sales are final. 13" & 15" chassis include tuners. Sh. Wt. 12 Lbs. each.
13" Chassis . . . 7DZ70059 . . . . $22.50
15" Chassis . . . 7DZ70060 . . . . $22.50
17" Chassis . . . 7DZ70061 . . . . $14.88
19" Chassis . . . 7DZ70062 . . . . $14.88

DIGITAL CLOCK / ALARM



New surplus clock alarm movement by General Time (Tally). This lighted digital movement was part of a clock/radio alarm, and has a 15 amp SPST switch to turn on radio (or whatever) at the time that you set. Numeral Height is 0.3". Overall dimensions are 5" wide x 3-1/8" deep x 2-¾" high. Runs on 115V, 60 Hz.
Sh. Wt. 6 oz. . . . . 7D70235. . . . . $4.00

GAST VACUUM PUMP

Model No. D10522 - P134, a carbon vane air pump suitable for both air compressors or vacuum pumps where clean oil free air is required. Vacuum Spec's.: max. cont. - 2.5 In.Hg.; max intermittent 30 In.Hg.. Compressor Ratings: max. cont. 15 PSIG; max. intermittent - 20 PSIG. Drive Motor: G.E. continuous duty, ball bearing type. Input 115V, 60 Hz. 1/3 HP, Speed 1725 RPM.

Body and mounting base are made of cast iron, overall size is 12" lg. x 8" hg. x 6" w. Inlet and outlet, female ¼"NPT. R.U.E., like new condition. Guarenteed.
Sh. Wt. 35 Lbs. . . 7PD70171 . . . $39.50

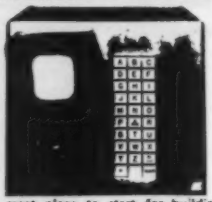
LARGE SPEAKER CABINET

This enclosure was intended to go into a system that is renowned to be the most accurate medium priced speaker on the market. Size: 25¾" high x 15¾" wide x 9¾" deep. Cabinet will accomadate a 10" woofer, a 4 or 5" midrange and a 4" tweeter. Walnut grained vynal exterior, black vynal front face. Qty. Ltd., With data & grill cloth.Sh. Wt. 18 Lbs. ea.
7OB70189 . . . . . $19.88 each
Pair for $34.88 . . . . . $34.88/pair

FERRIC CHLORIDE P.C. BOARD ETCHANT

New, packaged ferric chloride crystals in 1 Lb. bags. Use to make 64 oz. of P.C. board etching solution by simply adding water. Our competition sells 6 oz. of this for $3.95 . . . at our low price you get over 10 times as much for $3.00! Quantity is limited.
Sh. Wt. 1½ Lbs. . 7H70258 . . $3.00/bag
4 bags for $10.00 . . . . . $10.00/4 bags

INPUT/OUTPUT TERMINAL



A great place to start for building a microprocessor. These units were part of a comlex computer system. The terminal contains: keyboard; CRT; drive circuits; ASC11 output; and a complete 128 page technical manual with operating and repair instructions, which makes it easy to modify the terminal for your applications. (Character generator was part of a separate control section which is not supplied. The terminal can be used when modified using character generator LSI chips, such as the 2513, 2516 or other such IC's).

The keyboard is a 50 key alpha-numeric (and others) block keyboard, with ASC11 output. Display capactiy is 768 (12 lines of 64), 384, 256, 128 and so on, depending on character size desired. The character size may be adjusted from approximately typewriter size up to ¼".

The viewing screen of the CRT utilizes a high contrast, low persistence, emerald green phosphor. Each character is composed from a 5 x 7 dot pattern, registering clearly and sharply against a dark background. Controls provided include: on/off; brightness; focus; and character height.

Great as a microprocessor input & output device. The display stations are used, removed from airline reservation systems, hotel reservation systems, stock exchanges, etc. Sh. Wt. 35 Lbs.
NEVER BEFORE at this LOW PRICE!
6NB60336 . . $29.95 ea. . $100.00 for 4

POWER SUPPLY KITS

1. C.B. POWER SUPPLY KIT
A complete kit which puts out 10 to 24 VDC at 2 amps, regulated, 115 VAC in. Can be wired for content 13.8VDC, ideal & compact for C.B. Kit includes PC card, components and instructions . . . just add your own case. Super as a bench supply!
Sh. Wt. 6 Lbs. . . . 6C60498. . . . $14.88

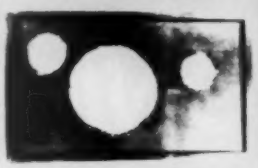
2. 5A, 10 to 24VDC Reg. P.S. KIT
A simple, adjustable regulated power supply. Kit includes all components, vector board and complete schematics. All you add is the case. A powerful supply!
Sh. Wt. 15 Lbs. . . 6MI60301 . . . $14.88

3. 0 to 30V AC/DC P.S. KIT
This high amp adjustable supply is an easy kit to build. It includes a 0 to 40 volt autotransformer (Variac®), 24V 5A transformer and all other components. Useful as a battery charger, bench supply or any use requiring high current.
Sh. Wt. 9 Lbs. . . . 6C60462 . . . $14.50

POSTAGE: Please add sufficient funds for postage and insurance. Shipping weight for merchandise is listed at the end of each product description. All shipping is from Peabody, Ma. 01960.
Mass. Residents Add 5% Sales Tax.

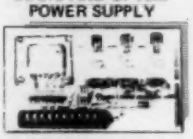
SEND FOR OUR FREE CATALOG!
Or, receive our catalog in an order and insure yourself of a place on our mailing list

BOOKSHELF OR FLOOR SPEAKER CABINETS



These are surplus from a local manufacturer who went broke. These have minor air leaks at the glued edges, which are easily sealed with some white glue. The cabinets have a walnut grain vynal clad finish. Each cabinet has a hole ready for an 8" woofer, plus 2 more holes for 4" tweeter(s) &/or midrange(s). Sold with grill cloth and data. Size: 21" high x 12" wide x 8" deep. Sh. Wt. 13 Lb./ea.
7OB70197 . . . . . $13.50 ea.
2 for $25.00. . . . . $25.00/pair

LOGIC AND OP AMP POWER SUPPLY



This regulated power supply has outputs of ±15 volts at 0.25 amps and +5 volts at 2.5 amps, with an input of 115 VAC. Manufactured by a computer company as part of a phone data terminal. Three (3) 723's (IC's) are used for voltage regulation. Units have barrier strip outputs, and are open frame. Size: 5" x 9" x 2". New surplus. Qty. Ltd.
Sh. Wt. 5 Lbs . . . 6MI60215 . . . $17.50
3 for $45.00. . . 6MI60215 . . $45.00/3

CONFERENCE CALLER KIT

Phone not included

Unique kit of parts allows you to connect up to 5 lines through switching and a special transformer. Unit will allow you to engage as many as 5 persons . . . no no matter where they are . . . in the same conversation just by dialing a number and flipping a switch. It's that simple, that quick. The "Conference Caller" can be attached to any multiple line telephone. There is no additional outside power required and no interference with normal phone service. Case not supplied.

Kit includes a special transformer, switches, cable, solid state parts and you supply the case. Complete with instructions and data.
Sh. Wt. 8 Lbs. . . . 7C70043. . . . ~~$19.88~~

Special 73 reader price this month!
. . . . . only $13.88

JOYSTICKS Two 10K POT'S

Super for X-Y functions: audio, computer, remote control, graphics, etc. Sh. Wt. 8 oz.
7J70163 . . . . . $4.95

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Bank Americard, Master Charge and American Express Accepted.
Phone: (617) 531-5774 / 532-2323
$10.00 Minimum on Charge Orders

B&F ENTERPRISES
119 FOSTER STREET
PEABODY, MA. 01960
(617) 531-5774/532-2323

TV TENNIS GAME KIT

1 or 2 players - 1 to 10 ball speed - dual paddle size - sound. These games were never finished at the factory. You do a little soldering and mounting to complete the work left undone. The IC board is already assembled and has passed Q.C. Just add some hardware to complete the project: a TV game for under $10. Complete with instructions, qty. ltd. Sh. Wt. 4 Lbs.
7ZU70250 . . $8.88 ea . . $69.99 for 10

DRINK MIXER KIT

Through a lucky purchase we obtained some new drink mixer parts. We have all parts except the top cover, but you can make your own or operate without it. Now you can build a $20.00 mixer for under $5.00. Great for shakes, kids love 'em. Includes motor, mixer, screws, line cord, stand, switch and 16 oz. mixer cup.
Sh. Wt. 5 Lbs. . . . 7M370053. . . . $4.88
Spare MIXER CUP for above:
Sh. Wt. 8 oz. . . 7M370054 . . $1.50 each

TOUCH-TONE GENERATOR CHIP

New, 2 of 8 encoder chip ME8900, (similar to the MC14410). Sold with data sheet on uses of MC14410 chip. No crystals required. Sh. Wt. 8 oz.
7VL70160 . . $6.95 ea. . . $60.00 for 10

MM5240 STATIC CHARACTER GENERATOR CHIP

64 - 8x5 characters, 2,560-bit. With data.
Sh. Wt. 8 oz. . . . 7IC70231. . . $6.00 ea.

MEMORY CHIPS

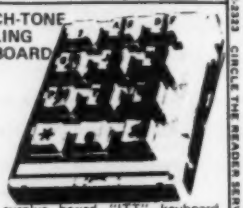
PROM's: Mfg. by MMI & Signetics

† **No. 6301**, 1024-bit, 256x4, TTL, equal to Fairchild 93427C/M
Sh. Wt. 8 oz. . . . .7IC70173 . . . .$2.00
(specify MMI 6301)

† **No. 6306** - 2048-bit, 512x4, TTL, equal to Fairchild 93446C/M
Sh. Wt. 8 oz. . . . .7IC70174 . . . .$2.00
(Specify MMI-6306)

† **No. 82S126 Signetics**, 1025-bit, 256 x4 TTL, equal to Fairchild 93417C/M
Sh. Wt. 8 oz. . . . .7IC70175 . . . .$2.00
(Specify Signetics 82S126)

TOUCH-TONE CALLING KEYBOARD



New surplus boxed "ITT" keyboard, just the thing to make your own touch-tone phone or repeater. You can use these with our dialer chips ME 8900, MC 14410 or our Auto Dialer kit No. 6MI60189. Supplied with typical applications circuit diagrams.
Sh. Wt. 8 oz.. . . . 7MI70162 . . . .$5.88
3 for $17.00. . . 7MI70162 . . . $17.00/3

GTE (AE) Used Touch-Tone Keyboard
Sh. Wt. 1 Lb . . . .6MI60182 . . . .$5.00

Chomerics Touch-Tone Keyboard - New
Sh. Wt. 8 oz. . . . 5MI00349 . . . .$4.50

B&F B4

PHONE ORDERS WELCOME! — (617) 531-5774/532-2323 — BANKAMERICARD / MASTER CHARGE / AMERICAN EXPRESS CARDS ACCEPTED

California Industrial

Post Office Box 3097 A • Torrance, California 90503

CALCULATOR WRIST WATCH

Designed for the on the go executive, that individual who has to make those on the spot decisions.

Handsome gold tone stainless steel watch features space age micro-circuitry. The MOS integrated circuit contains the equivalent of more than 10,000 transistors.

This LED wrist watch displays date, time, elapse seconds and also functions as an eight digit calculator with memory. Information stored in memory can be recalled at any later date, even weeks or months. Use this memory feature to store phone numbers, parking stall location or flight departure time.

Manufactured by one of California's leading aerospace contractors. Because of the discount price we have agreed not to publish the manufacturer's name.

Includes batteries, jewelry case and 18-month factory warranty.

$149.50

HEWLETT PACKARD

Professional Calculators

DISCOUNT PRICES

HP-21 Top quality, full scientific	$ 69.95
HP-22 Financial with ten memories	109.75
HP-25 Top programmable, 49 program steps	129.50
HP-25C Same as HP-25 plus limited AV	159.50
HP-27 Financial, scientific, statistical	149.95
HP-67 Most fully programmable, 224 steps	319.50
HP-80 Financial with hard holder	259.50
HP-91 Scientific print out display	375.00
HP-97 Fully prog scientific, print out display	650.50

FREE

MANUAL GRAPHITE DISPLAY GENERATOR

Modern technology has pioneered the development of this unique character printer. Our Manual Graphite Display Generator has the capability of producing the full upper and lower case ASCII set. Self-contained cursor assembly allows the operator to eliminate erroneously entered information.

Each unit is manufactured to strict tolerances as prescribed by standards set forth by California Industrial. One free with every order.

HEXADECIMAL KEYBOARD

Maxi-Switch hexadecimal keyboards are designed for microcomputer systems that require 4-bit output in standard hex code.

Each assembly consists of 16 hermetically sealed reed switches and TTL "one-shot" debounce circuitry.

Reliable low friction acetal resin plungers are credited for the smooth operation and long life of this premium keyboard.

Requires single + 5 volt supply.

$29.95

DIGITAL ALARM CLOCK

Completely Assembled $19.95

Walnut-grained decorator clock features large .7" LED display which is driven by the new National MM5385 alarm clock chip. Preset 24-hour alarm function allows you to awaken at the same time each morning without resetting. Upon reaching the wake-up time, the clock's loudspeaker emits a gentle tone. Touch the snooze button and doze off for an additional 9 minutes of sleep. Clock also functions as a ten-minute elapse timer. "Alarm Set" indicator, AM-PM display.

CONNECTORS

RS-232

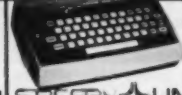
DB25P male plug & hood **$3.95**

DB25S female **$3.95**

$4.98

100 PIN IMSAI/ALTAIR Edge Connector

Altair, Imsai compatible gold plated, dual 50 (.125 centers) three tier wire wrap edge connector. 3 for $13.50



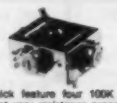
$24.88

SPERRY UNIVAC

KEYBOARD

The famous Sperry Univac 1710 Holerith keyboard assembly is now available from California Industrial for only $24.88. The ideal computer input device for accountants and mathematicians. The numeric keys are placed on the lower three rows to resemble a ten key adding machine. This format allows one handed numeric data entry. Original cost was $385. Used but guaranteed in excellent condition. Complete with documentation.

JOYSTICK $5.50



This joystick feature four 100K potentiometers, that vary resistance proportional to the angle of the stick. Perfect for television games, quad stereo and radio controlled aircraft.

POWER SUPPLIES

$17.50

$1.50 shipping

5 volt 2.2 Amp regulated power supply. Also delivers 12 volts at 4 Amps unregulated. Perfect for TTL applications.

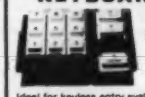
$4.98 **Scotch** BRAND

10 for $45. 3M

DISKETTES

IBM 3740 series and compatible drives

CALCULATOR KEYBOARD



$2.98

Ideal for keyless entry systems, burglar alarms, Touch Tone or hexadecimal computer input code.

$3.98 Digital Clock

Manufactured for the Panasonic clock radio. The clock mechanism trips a microswitch upon reaching your preset wake-up time.

intel **2708**

$29.95

8K UV Erasable MEMORY

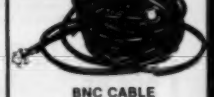
SUPERECTIFIER

$1.95

BRIDGE RECTIFIER

MOTOROLA 12 Amp. 50 v.

$3.50



BNC CABLE

15 feet of RG-58U connector at ends

intel **2102AL**

1k RAM 450ns

$1.19 Lowest Price Anywhere

7400	09
7401	10
7402	10
7403	10
7404	10
7405	10
7406	3.49
7407	2.79
7408	10
7409	10
7410	10
7411	20
7412	20
7413	20
7414	79
7416	39
7417	39
7420	10
7421	20
7422	39
7423	20
7425	39
7426	20
7427	39
7428	39
7430	10
7432	20
7433	39
7437	39
7438	39
7439	39
7440	10
7441	89
7442	59
7443	79
7445	99
7446	1.19
7447	1.19
7448	1.19
7450	20
7451	20
7453	20
7454	20
7460	20
7470	39
7472	39
7473	39
7474	39
7475	79
7476	79
7479	3.99
7480	79
7482	1.79
7483	1.79
7485	1.79
7486	39
7489	3.49
7490	79
7491	89
7492	79
7493	79
7494	1.19
7495	89
7496	79
7497	3.99

CMOS

4000	25
4001	25
4002	25
4006	1.99
4007	25
4008	1.49
4009	89
4010	89
4011	25
4012	25
4013	49
4014	1.49
4015	1.49
4016	59
4017	1.89
4018	1.79
4019	1.79
4020	1.89
4021	1.89
4022	1.89
4023	25
4024	1.49
4025	25
4026	3.49
4027	89
4028	1.89
4029	1.89
4030	59
4031	3.49
4032	1.89
4033	1.89
4034	3.49
4035	1.89
4040	1.49
4041	1.49
4042	1.49
4043	1.49
4044	1.49
4047	2.49

4048	79
4050	79
4051	1.89
4052	1.49
4053	1.89
4060	1.89
4066	1.19
4068	49
4071	49
4077	79
4081	49

MEMORY

1702	5.95
8pin23	2.95
8pin2513	2.95
2102	1.79
2102-1	1.89
21L02	1.59

CPU's

8080A	24.95
6800	24.95
Z80	69.95

CLOCK's

5314	3.95
5316	4.95
5375	3.95

LM741 $.09*

300H	79
301H	29
301CN	39
304H	1.79
305H	1.79
307H	39
307CN	39
308N	1.49
308CN	1.49
309K	1.19
309H	1.19
311N	89
312N	1.99
318N	3.95
319CN	1.49
320K-5	1.99
320K-12	1.99
320K-15	1.99
320T-5	1.99
320T-8	1.75
320T-12	1.75
320T-15	1.75
324N	1.99
339N-24	1.75
340K-5	1.95
340K-8	1.95
340K-12	1.95
340K-15	1.95
340T-5	1.79
340T-8	1.79
340T-12	1.79
340T-15	1.79

340T-24	1.79
350N	89
351CN	89
370H	1.29
372H	1.29
373N	3.19
377N	3.99
378N	1.39
379N	1.39
380N	1.79
381N	1.79
382N	1.79
7805K	49
7812K	49
7815K	49
7824K	49
7905K	1.29
7912K	1.29
7915K	1.29
7924K	1.29
7805K	49
7812K	49
7815K	49
7824K	49
7905K	1.29
7912K	1.29
7915K	1.29
7924K	1.29
7418N	79
7419N	79
7711N	39
7420N	39
7723H	55
7725H	55
7730N	3.49
7731H	1.49
7733N	99
7736N	99
7741N	1.19
7418N	79
7419N	79
7711N	39
7420N	39
7723H	55
7725H	55
7730N	3.49
7731H	1.49
7733N	99
7736N	99
7741N	1.19
74161N	1.79
1458	89
7486N	89
7488N	89
7489N	2.99
7805K	2.99
7812K	2.99
7815K	2.99
7824K	2.99

"We want to give them away — but our accountants won't let us. So instead we are selling them at cost. And therefore must limit the purchase of the SN7400 and the LM741 to 50 per customer.

MEMORY

1702	5.95
8pin23	2.95
8pin2513	2.95
2102	1.79
2102-1	1.89
21L02	1.59

CPU's

8080A	24.95
6800	24.95
Z80	69.95

CLOCK's

5314	3.95
5316	4.95
5375	3.95

Compucorp DIGITAL CASSETTE RECORDER

$79.50

The Compucorp 392 cassette recorder is engineered exclusively for storage and retrieval of binary digital information.

The recorder does not require tone detection or analog interface boards. High-low binary state is detected through a self contained digital transition amplifier. The upper half of the recorders stereo head is used for detection of self clocked pulse signals. Information received from the CPU advances the capstan driven tape transport. Control cable terminates into a 25 pin male "RS-232" type connector. Documentation included. Limited quantities.

SOLID-STATE

$.98

1.5 TO 3 VDC

MICRO BUZZER

Thumbwheel switch

Ten position **BCD**

$1.39 ea.

10	50	100	1k
$1.19	.89		

SPDT MINIATURE TOGGLE SWITCH

$.98 ea.

10	50	100	1k
.88	.81	.73	.66

TRIMMER POTENTIOMETERS

2K 10K 50K

5 for $.98

20	50	100
16¢	14¢	12¢

CAPACITORS

ELECTROLYTICS

	ea.	10	50
4500/50v.	$3.99	1.35	1.19
1000/15v. axial	.85	.69	.65

.1 disc	$.12	10	.08
.01 disc	.06	.05	.04

$.98 ea.

DPDT ROCKER SWITCH

DIP Switch

$1.95 ea.

10	100	1k
$1.74	1.55	1.39

8x SPST

32 Conductor RIBBON WIRE SPECTRA-STRIP

$.49 Ft.

COMPUCORP Power Adapter

shipping $.75

output 7vdc 1.4A

$4.98

COMBINATION LENS MOUNTING DEVICE

Red Amber Green

5 for $.98

20	50	100	1k
17¢	15¢	13¢	11¢

CLIP LITE

Transistors

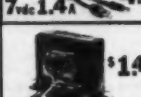
	ea.	10	50	100
2N2222A	.20	.18	.16	.15
2N3055	.89	.84	.77	.65
MJ3055	.99	.94	.87	.75
2N3772	2.19	1.95	1.75	1.59
2N3904	.15	.11	.09	.07
2N3906	.15	.11	.09	.07

Diodes

	10	25	100
1N4002 100v.	.08	.06	.05
1N4005 600v.	.10	.08	.07
1N4148 signal	.07	.05	.04

jumbo red **LED's** ea. 10 25 100 $.15 .13 .11 .09

$1.49



Output: 12v. 175ma.

TRANSFORMER

3 For $.98

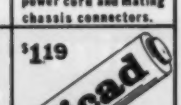
8-WAY BINDING POSTS

9 foot

$1.49

Heavy duty grounded power cord and mating chassis connectors.

$1.19



AA NICAD BATTERY

DISCOUNT

Wire Wrap Center

IC SOCKETS

pin	Wire Wrap ea.	25	50	Solder ea.	25	50
8				17¢	16	15
14	37¢	36	35	20	19	18
16	38	37	36	21	20	19
24	99	93	85	36	35	34
40	$1.00	$.95	$.89	63	60	58

KYNAR WIRE WRAP

50ft. **$.98**

500	1,000	11,000
$8.	$15.	$105.

$29.95

ON HOBBY WRAP-30 wire wrap & strip tool

$5.45

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NEW

DIGITAL CLOCK with 10 MINUTE TIMER

6 digits – 12/24 hour

Here's the kit everyone has been asking for! Never fail to identify your station again. And it's easy to use, just tap timer button to start, 9 minutes later the display will flash on and off to alert you. Reset it by simply touching the timer button or it will reset itself automatically after two minutes! Other features are: jumbo .4" LED readouts, durable extruded aluminum case available in 5 colors, plug transformer, Polaroid lens filter, time set buttons, finest quality PC boards and super instructions. You get all parts – no extras are needed, unlike some of the kludges our competitors offer! Colors available: gold, black, silver, bronze, blue (specify). Size: 4.25" x 1.5" x 1.5".

Clock Kit with 10 min. timer, DC-10 ..... $25.95
Regular 12/24 hr clock kit 22.95
Alarm clock, 12 hr only, DC-8 ..... 24.95
Kits are also available fully assembled and tested, just add $10 to kit price.

CAR CLOCK 12/24 HR 6 DIGIT $25.95

- High accuracy (1 minute/month)
- Big .4" LED display
- Special circuit suppress all voltage spikes and transients
- Same case as illustrated above
- Display blanks with ignition off
- Reverse polarity protected

Complete Kit, DC-7 ..... $25.95
Assembled and calibrated ... 35.95

CALENDAR ALARM CLOCK 6 Digit LED 12/24 Hour

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car! **FEATURES:**

- 6 Digits, .5" High LED
- 12/24 Hour Format
- Calendar shows mo./day
- Snooze button
- True 24 Hour Alarm
- 7001 chip does all!!!
- Battery back up with built in on chip time base

Complete Kit, less case, DC-9 ..... $34.95

600 MHz PRESCALER $59.95

Assembled and tested. Extend the range of your counter to 600 MHz. Works with all counters. Available in kit form for $44.95. Specify ÷10 or ÷100 with order.

30 WATT 2 Meter Power Amp

The famous RE class C power amp now available mail order! Four Watts in for 30 Watts out, 2 in for 15 out, 1 in for 8 out. Incredible value, complete with all parts, instructions and details on T-R relay. Fully stable, output short proof, infinite VSWR protected! Case not included.

Complete Kit $22.95

COMING SOON: VIDEO TERMINAL KIT

SEND FOR DETAILS
$149.95

SPECIAL

TTL		LINEAR		REGULATOR		TRANSISTORS	
74500	.35	555	.50	309K	.99	NPN 2N3904 type	10/$1.00
745112	.75	556	.75	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.75	340K-12	1.25	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.99	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.99	FET MPF-102 type	3/$2.00
7490A	.55	75491	.50	7815	.99	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.99	2N3055 NPN Power	.75

DIODES: 1KV,2.5A ..... 5/$1.00 100V,1A ..... 10/$1.00 1N914A type ..... 50/$2.00

LED DISPLAYS

FND 359 ..... .4" C.C. ..... .75
FND 510 ..... .5" C.A. 1.25
DL 707 ..... .33" C.A. 1.25
HP 7730 ..... .27" C.A. 1.25
Red Polaroid Filter ... 4.25" X 1.125" ... .59

741 OP-AMP SPECIAL
Factory prime mini dip with both Xerox and 741 part numbers
10 for $2.00

SOCKETS

14 PIN	5/$1.00
16 PIN	5/$1.00
24 PIN	2/$1.00
40 PIN	3/$2.00

FERRITE BEADS
with info and specs
15/$1.00
6 hole Balun Beads
5/$1.00

SOCKET KIT
Assortment of 12 most used IC sockets. Good to have around the shop. $1.95

8080A $18.95
Factory Prime – includes FREE socket!

21L02-1 $1.95 Fast 450 ns Low Power

60 Hz XTAL TIME BASE
- Runs on 5-15 VDC
- Low current (2.5 ma)
- Operate clocks in car, boat, plane
- 1 minute/month accuracy

Kit, TB-7 ... $5.50
Assembled & Calibrated ... $9.95

CHEAP CLOCK KIT $9.95
DC-4 Features:
- 6 digit .4" LED
- 12 or 24 format

Does not include board or transformer

PC Board $2.95
Transformer $1.49

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FM Wireless Mike Kit $2.95 FM-1

Transmit up to 300' to any FM broadcast radio. Sensitive mike input requires crystal ceramic or dynamic mike. Runs on 3 to 9 V. Super sensitive model FM-2 .. $4.95

TONE DECODER KIT

A complete tone decoder on a single PC Board. Features: 400-5000 Hz adjustable frequency range, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.

Complete Kit, TD-1 ..... $4.95

LED BLINKY KIT

A great attention getter which alternately flashes 2 Jumbo LEDs. Use for name badges, buttons, or warning type panel lights. Runs on 3 to 9 volts.

Complete Kit $2.95

SUPER-SNOOP AMPLIFIER

A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.

Complete Kit, BN-9 ..... $4.95

MUSIC LIGHTS KIT

See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.

Complete Kit, ML-1 ..... $7.95

SIREN KIT

Produces upward and downward wail characteristic of police siren. 5 Watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.

Complete Kit, SM-3 ..... $2.95

CODE OSCILLATOR KIT

Powerful 1 watt audio oscillator of approx. 1 kHz, good for many uses. Great for warning alarm, battery checker, voltage indicator and code oscillator.

Complete Kit, CPO-1 ..... $2.50

POWER SUPPLY KIT

Complete triple regulated power supply provides variable ±15 volts at 200 mA and +5 volts at 1 Amp. 50 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8 V at 1 Amp and 18 to 30 VCT.

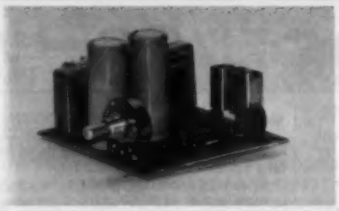
Complete Kit, PS-3LT $6.95

DECADE COUNTER PARTS KIT

INCLUDES $3.50
- 7490A decade counter
- 7475 latch
- 7447 LED driver
- LED readout
- Current limit resistors

Complete with instruction and details on how to build an easy, low cost freq. counter. **R8**

ADVA



KIT $11.95

ASSEMBLED $17.95
ADD $1.25 FOR POSTAGE/HANDLING

VARIABLE POWER SUPPLY

- Continuously Variable from 2V to over 15V
- Short-Circuit Proof
- Typical Regulation of 0.1%
- Electronic Current Limiting at 300mA
- Very Low Output Ripple
- Fiberglass PC Board Mounts All Components
- Assemble in about One Hour
- Makes a Great Bench or Lab Power Supply
- Includes All Components except Case and Meters

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LOGIC PROBE KIT—Use with CMOS, TTL, DTL, RTL, HTL, HiNIL and most MOS IC's. Built-in protection against polarity reversal and overvoltage. Draws only a few mA from circuit under test. Dual LED readout. Complete kit includes case and clip leads. **ONLY $7.95**

FIXED REGULATED POWER SUPPLY KITS—Short-circuit proof with thermal current limiting. Compact size and typical regulation of 0.5% make these ideal for most electronic projects. Available for 5V @ 500mA, 9V @ 500mA, 5V @ 500mA, 12V @ 400mA, 15V @ 300mA. Specify voltage when ordering. **$8.95 ea.**

These easy-to-assemble kits include all components, complete detailed instructions and plated fiberglass PC boards. Power supply kits do not include case or meters. Add $1.25 per kit for postage and handling.

MAIL NOW! FREE DATA SHEETS supplied with many items from this ad. **FREE ON REQUEST**—741 Op Amp with every order of $5 or more—740 Dual Op Amp or two E100 FET's with every order of $10 or more, postmarked prior to 3/31/77. One free item per order. **ORDER TODAY**—All items subject to prior sale and prices subject to change without notice. All items are new surplus parts—100% functionally tested.

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1N456 to	6/$1	2N720	.42	2N4121	3/$1	CP643	$0.60	LM340T-6	1.75
1N4002		2N918	3/$1	2N4122	3/$1	CP650*	$0.60	LM340T-12	1.75
1N4003 to	6/$1	2N1613	$0.29	2N4124	5/$1	CP651	$0.60	LM340T-15	1.75
1N4400		2N1711	.29	2N4249	5/$1	E100	4/$1	LM340T-24	1.75
1N4745 to	4/$1	2N1890	.39	2N4249	5/$1	E101	3/$1	LM370N*	.55
1N4759		2N1893	.39	2N4250	4/$1	E102	3/$1	LM377N	2.00
1N914*	10/$1	2N2218	.34	2N4274	5/$1	E175	3/$1	LM380N	1.29
1N962 to	4/$1	2N2222	6/$1	2N4302	$0.29	MPF102 to*	3/$1	NE565V*	2/$1
1N5314		2N2222A*	5/$1	2N4303	.29	MPF104	.55	NE566A	$0.50
1N3064	6/$1	2N2369	5/$1	2N4338	.51	MPF112	4/$1	LM709CH	.29
1N3600	6/$1	2N2060 to	.52	2N4360M	3/$1	MPS6515	3/$1	LM709CN	.29
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1N4002	12/$1	2N2060	$0.24	2N4392	$0.99	SE1002	4/$1	LM723N*	3/$1
1N4003	12/$1	2N2060A	.24	2N4416	2/$1	SE2001	4/$1	LM739N	$1.00
1N4004	12/$1	2N2097*	5/$1	2N4416A	$0.89	SE2002	4/$1	LM741CH	3/$1
1N4005	10/$1	2N2060	$1.50	2N4859 to	$1	SE4001 to	3/$1	LM741CN*	4/$1
1N4006	10/$1	2N2363	5/$1	2N4861		SE4003	3/$1	LM741CN14	.34
1N4007	10/$1	2N2364	4/$1	2N4867E	2/$1	SE5033	$0.80	LM747CN	.65
1N5140	10/$1	2N2484		2N4868E	2/$1	TIS73 to	3/$1	748CJ DIP	.35
1N4144*	25/$1	2N2583 to	5/$1	2N4881	$2.50	TIS75		748CJ DIP	1.00
1N4370 to	2/$1	2N2638	5/$1	2N4869	$1	DIGITAL IC's		8440F mDIP	.80
1N4372		2N2638A	5/$1	2N4905	3/$1	MM57309	$2.50	LM1304N	1.15
1N4454	10/$1	2N3041	5/$1	2N4967	4/$1	SN7400N	15	LM1458N*	2/$1
1N4730 to	3/$1	2N3042	5/$1	2N5033	4/$1	SN7402N	15	LM2111N	$1.40
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1N4154 30V 1N914	25/$1	LM324 Quad 741 Op Amp	.94
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LM2111	FM IF Amp/Limiter/Detector	.99
CA3028A	RF/IFAmplifier DC to 120 MHz	1.45
RC4136	Quad 741 Op Amp—Low-Noise	.95
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Mini Grandfather Clock Kit

- Completely Electronic
- 100% Solid State
- All CMOS IC Construction
- 2 Quality Plated PC Boards 6.5" x 4.5"
- New, revised easy to follow instructions
- Large ½" LED readout with AM/PM & colon indicators
- Simulated LED swinging pendulum with syncronized tick-tock sound.
- Chimes the hour (ie: 3 times for 3 o'clock)
- Adjustable volume tone and sustain on the chime.
- LOW COST
- Complete with all parts including transformer & speaker.

$39.95 kit **$59.95 (assembled & checked out)**

SOLID WOOD CLOCK CASE

Handcrafted specifically for the Grandfather Clock (see picture above)
MADE FROM SELECT SOLID HARDWOOD. These beautiful cases are custom cut for the Mini Grandfather clock and available in either ASH or WALNUT. Case comes with pre-cut ruby front lens and back panel. The PC boards slide easily into two internal grooves to make installation quick and easy. Choose from the following:

Complete case assembled and finished – **$19.95**
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PLEASE SPECIFY TYPE OF WOOD DESIRED, ASH OR WALNUT

TAKE automatic 10% Discount on *MDSE.* orders of $50.00 or over.

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ORDER US-01 **$19.95**

AUTOMATIC TIME-OUT CIRCUIT

Gives a 17 second entry delay, then triggers an alarm, light, etc. with 5–10 minute (selectable) time. Device rearms itself after the cycle. Directly compatable with the US–01 and Warble Alarm. Triggers on a "low" going transistion. Requires 12 VDC Will source or sink up to 200MA. **$3.95**

WARBLE ALARM KIT

Everybody is talking about it! A dual tone ear shattering sound that is impossible to ignore. Resembles the European siren sound. EASY to assemble!

$2.50

All necessary components & PC board, Less speaker.
5 to 10 watts output depending on speaker impedence. Useable from 3 to 15V (lower voltages gives reduced output). Requires 1 amp for full output.

OUR CUSTOMERS WRITE ABOUT OUR CDI KIT:
"...great kit."
"...unbelievable value", "...good design!"
"...fantastic kit and service. Send three more."

The CDI kit is all these things and more. Get in on a one-time deal. Complete electronics.
Requires heatsink (not included) also works for voltage source for high intensity strobe.
$9.95 **B8**

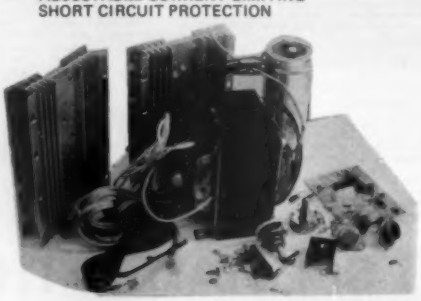
SMILING JACK SPECIAL! CLOCK/TIMER KIT (MK-03)

May we recommend the Aircraft Clock/Timer? Features 24 hour Zulu time and up to 24 hours of elapsed time on the same set of six digit LED readouts. Totally independent operation of both functions. Clock has presettable alarm with 10 minute snooze. Timer has reset, hold, and count functions. Full noise and overvoltage protection. 24 hour only. Readouts has dimmer feature or they can be turned off without disturbing the clock or timer. Timebase included (.01% accuracy). Because of the many options and mounting considerations the case and switches are not included. Switches are standard types. Will fit inside standard aircraft instrument case or the medium shadow case (see BF-01).

9–14VDC 150MA W/readouts on
40MA W/readouts off **$26.95**

PS–12 HIGH CURRENT VARIABLE POWER SUPPLY KIT
A LOW COST WAY TO HAVE A QUALITY VARIABLE BENCH SUPPLY.

ALL ELECTRONICS SUPPLIED
LARGE COMPUTER GRADE FILTER
PLATED PC BOARD
UNIQUE PRE-REGULATOR ALLOWS COOLER OPERATION AT HIGH CURRENTS.
3 to 16V & 15 to 30V (two ranges) @ 10A CONTINUOUS (15A with fan cooling)
ADJUSTABLE CURRENT LIMITING
SHORT CIRCUIT PROTECTION



$49.95 Regulation: 240mv Load & Line
Ripple: Less than .5V @ 30V & 10A.

Add $3.70 for UPS shipping. Outside continental U.S. Add $10.00 for Parcel Post & Insurance.

OVER-VOLTAGE PROTECTION KIT (OVP–1) **$6.95**

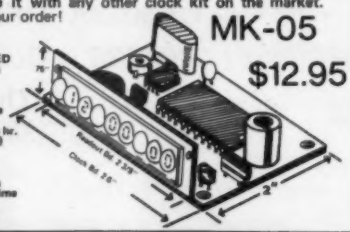
The OVP-1 will protect your expensive gear from voltage surges, power supply malfunction or tampering hands on your voltage adjust. Every regulated power supply should have one. Cheap insurance for expensive equipment. Adjustable from 3 to 30 volts DC. Useable on Supplies up to 25 amps. Power supply must be fused. Directly compatable with the PS-12 Power Supply. PC board and all parts suppled, including 25A SCR.

6 DIGIT MINI MOBILE ALARM CLOCK KIT

Many of our customers who have bought our other mobile clock kits (MK-03 & MK-04), have requested a small mobile clock for in dash mounting. We put our engineer to work on it and the result is the compact MK-05. Designed to be a mobile clock from the ground up. There has been no compromise on quality. **Take a look at the specs, price, size and compare it with any other clock kit on the market.** We will be waiting for your order!

- Quartz crystal timebase
- Toroid and zener noise & voltage protection
- Magnified .15 inch, 6 digit LED readout with spacing between hours, minutes, & seconds
- Top Quality epoxy glass PC boards are drilled & plated
- No additional components are required
- Complete with presettable 24 hr. alarm (speaker NOT included)
- Can be used as elapsed timer
- Easy, quick assembly
- 9–14 VDC @ 40 to 50 ma
- Readouts can be turned off & the clock continues to keep time
- PC board Clock: 2.8"x2" Readout board: 2 3/8"x.78"

MK-05
$12.95

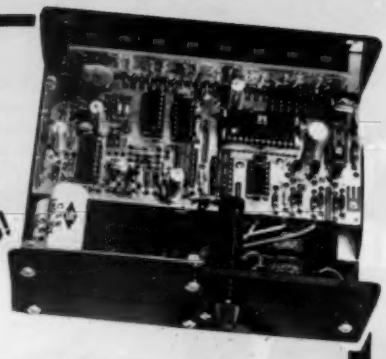


TERMS: NO COD's * Send check or M.O. * Add 5% postage Tx. Residents add 5% sales tax * Foreign add 10% (20% airmail) Orders under $10. add 60c handling * Repair service available Accepting phone orders on Master Charge and Bankamericard.

NEW LSI TECHNOLOGY

FREQUENCY COUNTER

TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION [PORTABLE BATTERY OPERATION IS NOW PRACTICAL], DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!



.4" DIGITS!

SIZE:
3" High
6" Wide
5½" Deep

1¾ LBS.
COLOR:
BLACK

FACTORY DIRECT PRICES

KIT #FC-50C	60 MHZ	COUNTER WITH CABINET & P.S.	$99.85
KIT #PSL-350	350 MHZ	PRESCALER [NOT SHOWN]	23.95
KIT #PSL-650	650 MHZ	PRESCALER [NOT SHOWN]	29.95
MODEL #FC-50WT	60 MHZ	COUNTER WIRED, TESTED & CAL.	165.95
MODEL #FC-50/600 WT	600 MHZ	COUNTER WIRED, TESTED & CAL.	199.95

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED. PRESCALERS WILL FIT INSIDE COUNTER CABINET.

FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
[AUTO DEC. PT. PLACEMENT]
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [± .0001%]: AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5.2 V DC AT 800 MA. REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS
INPUT CONNECTOR: BNC TYPE

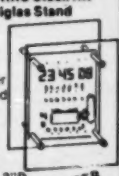
PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Plexiglas Chassis serves as Bezel to increase contrast of digital displays.

CABINET I 3"H,6¼"W,5½"D — Black, White or Clear Cover
CABINET II 2½"H,5"W,4"D — $6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" 95¢ ea. 4/$3

SEE THE WORKS Clock Kit Clear Plexiglas Stand



- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- All parts included

Plexiglas is Pre-cut & drilled
Kit #850-4CP
Size: 6"H,4½"W,3"D
$23.50 ea. 2/$45. A SUPER CLOCK!

60 HZ. XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC. 1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM
#TB-1 (Adjustable)
Complete Kit $4.95
Wir & Cal $9.95

SPECIAL PRICING!

PRIME - HIGH SPEED RAM

21L02-3 400 NS

LOW POWER - FACTORY FRESH

1-24	$1.95 ea	100-199	$1.60 ea
25-99	1.75 ea	200-499	1.45 ea

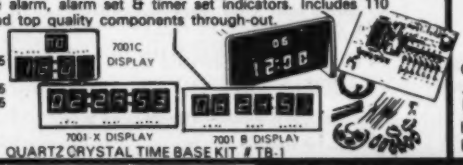
OVER 500 PCS. $1.39 ea.

6-DIGIT LED CLOCK CALENDAR KIT

DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.



KIT - 7001B WITH 6 - .5" DIGITS $39.95
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
KIT - 7001X WITH 6 - .6" DIGITS $45.95

KITS ARE COMPLETE (LESS CABINET)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT # TB-1

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.
Specify for 7001 B, C or X - $7.95

JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer, Line Cord, Switches and all Parts. Ideal Fit in Cabinet II

Kit #5314-5 $19.95 2/$38.

JUMBO DIGIT CONVERSTION KIT $9.95 ea.
Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.
Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

AUTO BURGLAR ALARM KIT

AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND. KEYLESS ALARM HAS PROVISION FOR POS. & GROUNDING SWITCHES OR SENSORS. WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN. KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD. UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED. CMOS RELIABILITY RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM. DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS OR AVAILABLE WIRED AND TESTED.

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

MOBILE LED CLOCK

12/24 HR .4" DIGITS!

MODEL #2001 — 12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off In Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT [Less 9V. Battery] $29.95 EA. 3 OR MORE $27.95 EA.
115 VAC Power Pack #AC-1 $2.50 EA.
ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] Wired for 12-Hr. Op. if not otherwise specified. $39.95 EA. 3 OR MORE $37.95 EA.

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STORE: 823 S. 21 AVE.

master charge — BankAmericard

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COD ORDERS WELCOME
Orders Under $15 Add $1.00 Handling
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WE PAY ALL SHIPPING IN CONTINENTAL USA — OTHERS ADD 5% [10% FOR AIRMAIL]

Synthacoder

New!

☆ ALL NEW SYNTHESIZER/ENCODER FROM ENGINEERING SPECIALITIES
THE ULTIMATE IN FREQUENCY CONTROL FOR IC-22S OWNERS!

No more soldering diodes every time you want to try a new repeater!
Just plug the Synthacoder into the back of your radio, select channel 22, and the Synthacoder takes command of your radio – Giving you fingertip control of ALL frequencies.

- Front Panel Thumbwheel Control of All Channels!
- Fully Automatic Invalid Code Control!
- Small Size: 3¾" x 1½" x 6"
- Factory Wired and Tested
- Easy To Install

SPECIAL
only $87.95
postpaid
CA Residents add 6% sales tax

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(805) 486-0817

☐ I'LL BITE! Please send more info.
☐ I'M HOOKED! Please RUSH my Synthacoder.

YES, I would like to purchase a Synthacoder for my IC-22S. Enclosed please find my $87.95 (Price includes postage and handling). California residents add 6% sales tax.

$_____ enclosed. ☐ Cash ☐ Check ☐ Money Order
Please charge my ☐ Master Charge ☐ BankAmericard
Credit card #_____
Interbank #_____
Expiration date_____
Signature_____

Name_____ Call_____
Address_____
City_____ State_____ Zip_____

E12

WE PAY POSTAGE!

D R C ELECTRONICS

P. O. Box 401247, Garland, Texas 75040 (214) 271-2461

If your computer uses the S-100 buss; **D.R.C.** is a name you will want to know.

Send us your name.

ROTARY SWITCH
Instrument grade. 6 Pole. 3 Position. Centralab.
$.99 each

1 AMP RECTIFIERS
House Numbered. Factory marked units. **All** meet 200 PIV minimum. Many up to 1,000 PIV.
30 FOR $1
Full Leads.

16 PIN IC SOCKETS
Low profile. Solder Tail.
5 FOR $1

ZENERS
1 W. 15 V. House Number. Motorola.
5 FOR $1

IN4748 1 W. 22 V. Motorola.
10 FOR $1

CALCULATOR DISPLAYS
Brand New Units By BOWMAR. Common Cathode.
.11 INCH CHARACTER.
9 DIGIT - $.99
6 DIGIT - $.69

MYLAR CAPACITOR
1 MFD. 400 VDC. 5%.
2 FOR $1

THERMISTOR
1 K OHM at Room Temp. Very Sensitive.
4 FOR $1

2708 **2708**
1KX8 EPROMS
Prime new units from a major U.S. mfg. 650 N. S. access time. Equivalent to four 1702A's in one package!
GOING INTO BUSINESS SALE! **$15.75 each**

741C OP AMPS
MINI DIP. Prime New Units. Has computer MFG's house number.
12 FOR $2
100 FOR $15

OPCOA LED READOUT
SLA-1 Common Anode. .33 In. character size. The original high efficiency LED display.
$.75 each
4 FOR $2.50

DISC CAPACITORS
.1 MFD 16 V. P.C. Leads Most Popular Value! P.C. Leads. By Sprague.
20 FOR $1

TANTALUM CAPACITOR
1 MFD. 35 V. Kemet. Axial Lead. Best Value.
10 FOR $1

POWER RESISTORS
.5 OHM 50 WATT. Adjustable 5%
2 FOR $1

3 OHM 15 WATT. 5%
3 FOR $1

.25 OHM 3 WATT. 1% IRC
4 FOR $1

POWER ZENER
IN3998A 10 W. 6.2 V.
2 FOR $1 W/HDWR

TRANSISTORS

2N3566 - TO - 5 plastic. NPN. VCEO-40 HFE 150 TO 600
10 FOR $1

MPS-6566 - TO - 92 plastic. NPN. VCEO-45 HFE 100 TO 400
10 FOR $1

T1S92 - TO - 92 plastic NPN.
10 FOR $1

EN3906 - TO - 18 plastic. PNP. VCEO-40 HFE 100 TO 300
10 FOR $1

2N3904 - House # - TO - 92 NPN. VCEO-45 HFE 100 TO 300
10 FOR $1

2N3616 Motorola TO - 3 Power PNP Germanium. 85 W. 75 V. 7 AMP.
2 FOR $1

TERMS: ORDERS UNDER $15 ADD $.75. NO C.O.D. WE ACCEPT VISA AND MASTER CHARGE CARDS. MONEY BACK GUARANTEE ON ALL ITEMS.

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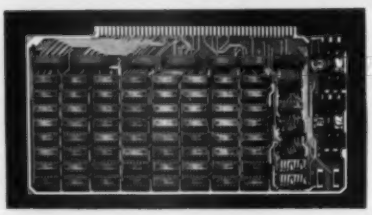
D R C **ELECTRONICS** P. O. BOX 401247 • GARLAND, TEXAS 75040 • (214) 271-2461

. . . and some stuff from our NEW FLYER !

SURPRISE ! lower prices ...more choice 74LS TTL

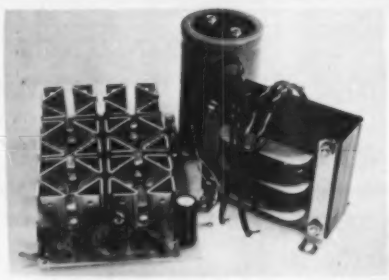
74LS00	$0.30	74LS139	1.15
74LS01	0.30	74LS151	0.95
74LS02	0.30	74LS155	1.38
74LS04	0.33	74LS157	0.95
74LS08	0.36	74LS160	1.40
74LS10	0.36	74LS161	1.40
74LS11	0.36	74LS162	1.40
74LS12	0.33	74LS163	1.40
74LS14	1.38	74LS168	1.87
74LS15	0.30	74LS169	1.87
74LS20	0.30	74LS173	1.65
74LS21	0.33	74LS174	1.25
74LS22	0.33	74LS175	1.15
74LS26	0.43	74LS240	1.88
74LS27	0.36	74LS257	1.25
74LS30	0.30	74LS258	1.25
74LS32	0.38	74LS266	0.53
74LS37	0.45	74LS283	1.20
74LS38	0.45	74LS365/	
74LS42	0.98	80LS95	0.75
74LS47	1.00	74LS366/	
74LS48	0.98	80LS96	0.75
74LS74	0.50	74LS367/	
74LS75	0.68	80LS97	0.75
74LS76	0.50	74LS368/	
74LS86	0.50	80LS98	0.75
74LS109	0.50	74LS386	0.55
74LS125	0.63	81LS95	1.13
74LS126	0.63	81LS96	1.13
74LS132	1.25	81LS97	1.13
74LS138	1.10	81LS98	1.13

8K Econoram II T.M.



Sure, anybody can throw together an 8K RAM...or there wouldn't be so many available! But those who know memory recognize the Godbout board as not just an exceptional value (it's no secret we know how to keep costs down), but as an example of how to pack extra options into a basic memory board. Extras like a vector interrupt provision if you try to write into protected memory. An ALL STATIC design, eliminating the timing and refresh requirements of dynamic types. It zips along at 450 ns, with a 1 wait state option for those of you with 4 MHz Z-80 machines...yet power is 1250 mA typ, and guaranteed to be less than 1.5 A. Selectable write strobe means you can use this board with or without a front panel. Each 4K block may be addressed independently for extra flexibility. And of course, there are sockets for all ICs, prime 2102-Ls, a super circuit board...1 year warranty on all parts...this isn't just another board, this is a board you can depend on.

KIT FORM **$163.84** ALSO AVAILABLE ASSEMBLED - $188.50



what a supply !

That 8A figure, by the way, is for continuous operation. We believe that RMS ratings are the most honest and conservative way to go...but this supply has enough reserve so that you can draw TWELVE AMPS with a 50% duty cycle. Our custom wound transformer, generous heat sinking, and conservative design make this possible. What else will you like about this supply? How about crowbar overvoltage protection... .05 Volt regulation, no load to full load...RF bypassing... and simple construction. All parts (except transformer, bridge, filters) mount on a single circuit board, and that includes the heat sinks and pass devices!* Whether for ham, CB, or bench use, this is a classy kit that lasts and lasts.

12V* 8A $39.95

*Case, chassis and hardware not included

*VARIABLE OUTPUT 11 - 14V

Grandson of a cheap clock

STILL $14.50 plus 1lb. post

Several years ago, we introduced our "Cheap Clock", a simple, unpretentious clock kit that has spawned numerous imitations. Later, we upgraded our kit with bigger readouts, brighter digits, and a bigger board; that was our "Son of a Cheap Clock". Our current clock is the "Grandson of a Cheap Clock"---and this time we have upped the digit size to .4", while retaining all the features that made the original clocks such big successes...like 6 digit operation, separate driver and segment transistors, 12/24 hour operation, 60 or 50 Hz capability, industrial quality PC board, IC socket to eliminate heat damage, and so on.

This is a complete clock kit...less only case. Unlike many of our imitators who charge extra for the PC board and transformer, we include both items---as well as time setting switches---in the package price. Our data sheet tells how to remote the readouts, how to use with a time base for battery or automotive operation, and assembly procedure. Note that despite the larger readouts, the price is not one penny higher than the "Son of a Cheap Clock".

TERMS: Add 50¢ to orders under $10. Please add 5% to cover shipping---more in the case of power supplies---excess refunded. We accept COD order if street address is included for UPS. To place BankAmericard®/VISA®/Mastercharge® orders ($15 minimum) call our 24 hour order desk at (415) 562-0636.

We thank you for your patronage and appreciate your comments.

GODBOUT

BILL GODBOUT ELECTRONICS
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FREE FLYER: If you haven't see one of our flyers lately, you are in for a surprise. See, we keep finding all these neat parts to carry...and we keep generating new kits...now we have books, more music kits, esoteric ICs, more Vector products...in short, stuff that delights the heart of the electronics hobbyist. All you have to do to get your own copy is to send us your name and address. We'll take care of the rest.

SEE YOU AT COMPUTERMANIA! **G4**

7400N TTL

SN7400N	.16	SN7455N	.25	SN74154N	1.00
SN7401N	.16	SN7460N	.22	SN74155N	.90
SN7402N	.21	SN7470N	.45	SN74156N	.90
SN7403N	.16	SN7472N	.39	SN74157N	.90
SN7404N	.18	SN7473N	.37	SN74159N	2.25
SN7405N	.24	SN7474N	.32	SN74161N	1.25
SN7406N	.39	SN7475N*	.53	SN74163N	.99
SN7407N	.29	SN7476N	.32	SN74164N	.99
SN7408N	.25	SN7478N	5.00	SN74165N	1.10
SN7409N	.25	SN7480N	.50	SN74170N	3.50
SN7410N	.18	SN7482N	.98	SN74174N	1.25
SN7411N	.30	SN7483N	.79	SN74175N	1.00
SN7412N	.33	SN7485N	.89	SN74176N	2.10
SN7413N	.45	SN7486N	.39	SN74177N	8.95
SN7414N	.75	SN7488N	3.50	SN74179N	1.50
SN7416N	.35	SN7489N	2.49	SN74180N	1.25
SN7417N	.25	SN7490N	.45	SN74181N	.90
SN7420N	.21	SN7491N	.75	SN74182N	.90
SN7421N	.33	SN7492N	.49	SN74187N	.90
SN7422N	.49	SN7493N	.49	SN74188N	.90
SN7423N	.37	SN7494N	.79	SN74189N	2.49
SN7425N	.29	SN7495N	.79	SN74190N	.95
SN7426N	.29	SN7496N	.69	SN74191N	1.95
SN7427N	.37	SN7497N	4.00	SN74192N	2.20
SN7428N	.42	SN74100N	1.00	SN74193N	10.00
SN7430N	.25	SN74107N	.36	SN74197N	9.05
SN7432N	.31	SN74121N	.39	SN74198N	3.95
SN7437N	.27	SN74122N	.39	SN74199N	1.19
SN7438N	.27	SN74123N	.59	SN74221N	1.25
SN7439N	.25	SN74125N	.69	SN74251N	.89
SN7440N	.19	SN74126N	.69	SN74253N	.99
SN7441N	.89	SN74132N	1.09	SN74279N	1.25
SN7442N	.59	SN74136N	.95	SN74298N	.75
SN7443N	.75	SN74141N	1.15	SN74365N	.75
SN7444N	.75	SN74143N	4.00	SN74366N	.75
SN7445N	.75	SN74145N	4.50	SN74367N	.75
SN7446N	.81	SN74147N	4.50	SN74368N	1.75
SN7447N	.69	SN74148N	1.15	SN74390N	5.50
SN7448N	.79	SN74147N	2.35	SN74279N	.90
SN7450N	.25	SN74149N	2.00	SN74251N	1.70
SN7451N	.27	SN74150N	1.00	SN74298N	8.00
SN7453N	.27	SN74151N	.75	SN74265N	6.00
SN7454N	.29	SN74153N	.89	SN74367N	.75

MANY OTHERS AVAILABLE ON REQUEST
20% Discount for 100 Combined 7400's

CMOS

CD4000	.25	CD4030	.65	74C04N	.75
CD4001	.25	CD4033	1.65	74C10N	.65
CD4002	.25	CD4035	1.65	74C20N	.65
CD4006	2.50	CD4040	2.45	74C30N	.65
CD4007	.25	CD4042	1.60	74C42N	2.15
CD4009	.59	CD4044	1.50	74C73N	1.50
CD4010	.59	CD4046	2.51	74C74	1.15
CD4011	.25	CD4047	2.75	74C90N	2.00
CD4012	.25	CD4049	.79	74C85N	2.00
CD4013	.47	CD4050	.79	74C107N	1.25
CD4016	.59	CD4051	2.95	74C151	2.50
CD4017	1.35	CD4053	2.95	74C154	4.00
CD4019	.55	CD4060	3.25	74C157	2.15
CD4020	1.40	CD4066	1.75	74C160	3.25
CD4022	1.25	CD4069	.45	74C161	3.25
CD4023	.25	CD4071	.45	74C163	3.00
CD4024	1.50	CD4081	.45	74C164	3.25
CD4025	.25	CD4511	3.50	74C173	2.60
CD4026	$3.65	CD4518	2.50	74C193	2.75
CD4027	.69	MC14585	3.00	74C195	2.75
CD4028	1.65	74C00N	.39	MC4044	4.50
CD4029	2.90	74C02N	.55	MC14016	.56

LINEAR

LM300H	.90			LM1351H	1.95
LM301H	.35	709C	1.75	LM1414N	1.75
LM301CN	.35	709N	1.75	LM1458C	.90
LM302H	.75	LM370N	1.15	LM1496N	.95
LM304H	1.00	LM373N	3.25	LM1556V	1.95
LM305H	.95	LM377N	4.00	LM1711N	1.95
LM307CN	.35	LM380N	1.30	LM2901N	2.95
LM308H	1.00	LM380CN	1.05	LM3085N	.69
LM308CN	1.00	LM381N	1.75	LM3900N	.55
LM309H	1.10	LM382N	1.75	LM3905N	.69
LM309K	.99	NE501X	8.00	LM3909	1.25
LM310CN	1.15	NE510A	6.00	LM5558N	1.95
LM311H	.90	NE531H	3.00	MC3556N	1.00
LM311N	.90	NE536T	6.00	LM7523N	.90
LM318CN	1.50	NE540L	6.00	LM7535N	1.25
LM319N	1.30	NE550N	.79	MC889	4.95
LM320K-5	1.35	NE555V	.39	LM79450	.69
LM320K-5.2	1.35	NE556N	5.00	75451CN	.39
LM320K-12	1.35	NE561B	5.00	75452CN	.39
LM320K-15	1.35	NE562B	5.00	75453CN	.39
LM320T-5	1.75	NE566H	1.25	75454CN	.39
LM320T-5.2	1.75	NE566N	1.75	75491CN	.79
LM320T-8	1.75	NE568CN	1.25	75492CN	.89
LM320T-12	1.75	NE567N	1.95	75494CN	.89
LM320T-15	1.75	NE587V	1.50	RCA LINEAR	
LM320T-18	1.75	LM703CN	.45	CA3013	2.15
LM320T-24	1.75	LM709H	.29	CA3023	2.50
LM323K-5	9.95	LM709N	.29	CA3035	2.49
LM324N	1.00	LM710N	.79	CA3039	1.30
LM339N	1.70	LM711N	.39	CA3046	1.30
LM340K-5	1.95	LM723H	.55	CA3059	3.25
LM340K-6	1.95	LM723N	.55	CA3060	3.25
LM340K-8	1.95	LM725CN	1.00	CA3080	.85
LM340K-12	1.95	LM739N	1.00	CA3081	2.00
LM340K-15	1.95	LM741CH	.35	CA3082	2.00
LM340K-18	1.95	LM741CN	.35	CA3083	1.40
LM340K-24	1.95	LM741-14N	.39	CA3085	.85
LM340T-5	1.75	LM747N	.79	CA3089	3.75
LM340T-6	1.75	LM747N	.79	CA3091	10.30
LM340T-8	1.75	LM748H	.39	CA3102	2.95
LM340T-12	1.75	LM748N	.39	CA3123	2.15
LM340T-15	1.75	LM13O3N	.90	CA3130	1.39
LM340T-18	1.75	LM1304N	1.19	CA3140	1.35
LM340T-24	1.75	LM1305N	1.40	CA3080	1.75
LM340N	1.00	LM1307N	.65	RC4195	5.95
LM351CN	.65	LM1310N	2.95	RC4196	3.25

74LS00 TTL

74LS00	.29	74LS74	.49	74LS139	1.95
74LS02	.29	74LS74A	.49	74LS151	1.55
74LS03	.29	74LS75	.69	74LS153	1.69
74LS04	.35	74LS76	.69	74LS157	1.55
74LS05	.35	74LS78	.49	74LS162	2.25
74LS08	.29	74LS83	1.75	74LS163	2.25
74LS10	.29	74LS85	2.49	74LS164	1.95
74LS13	.69	74LS86	.49	74LS173	1.95
74LS14	1.75	74LS90	1.25	74LS181	3.69
74LS20	.29	74LS92	1.25	74LS190	2.65
74LS26	.39	74LS93	1.25	74LS191	2.65
74LS27	.39	74LS95	1.95	74LS192	2.65
74LS28	.39	74LS96	1.80	74LS193	2.65
74LS30	.29	74LS107	.59	74LS194	1.69
74LS32	.39	74LS109	.59	74LS195	1.69
74LS40	.39	74LS112	.59	74LS251	1.75
74LS51	.29	74LS132	1.25	74LS260	.55
74LS55	.29	74LS136	.59	74LS279	.79
74LS73	.49	74LS138	1.69	74LS670	3.95

CLOCK CHIPS

MM5309	6 Digit, BCD Outputs, Reset Pin.	$9.95
MM5311	6 Digit, BCD Outputs, 12 or 24 Hour	4.95
MM5312	4 Digit, BCD Outputs, 1 PPS Output	4.95
MM5314	6 Digit, 12 or 24 Hour, 50 or 60 Hz	4.95
MM5316	4 Digit, Alarm, 1 PPS Output	6.95
MM5318	Video Clock Chip, For Use With (MM5041 - $9.95)	9.95
CT7001	6 Digit, Calendar, Alarm, 12 or 24 Hour	5.95

DATA HANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	$2.95
CMOS	Pin-out & Description of 4000 Series ICS	$2.95
Linear	Pin-out & Functional Description	$2.95
	ALL THREE HANDBOOKS $6.95	

T201 Black Bracelet LED $19.95

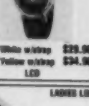
T237 White w/Bracelet $29.95
T235 Yellow w/Bracelet $34.95
LED

Timeband by FAIRCHILD — Watches —

Men's & Ladies

- Solid State
- Displays hour, minute, second, month & day
- Snap-out battery replacement
- Free set of replacement batteries
- Choose LED or LCD styles
- One year factory warranty

T0441 White w/strap $29.95
T0440 Yellow w/strap $34.95
LED



T311 White w/strap $34.95
T310 Yellow w/strap $39.95

CHANNEL F™ RAISED VIDEO ENVIRONMENT SYSTEM

$159.95

- Freeze Action • Speed Option
- Automatic time and scorekeeping
- Battery-free AC operation
- Dual controls with 8-way action
- Built-in Pro Hockey and Tennis games
- Easy hook-up on any B/W or Color TV
- Factory warranty

Channel F — additional cartridges — $19.95 ea.

#8112 - Desert Fox/Shooting Gallery
#8113 - Blackjack (1 or 2 players)
#8114 - Spitfire (1 or 2 players)
#8115 - Space War
#8111 - Tic-Tac-Toe/Shooting Gallery/Doodle/Quadra-Doodle

DISCRETE LEDS

	.125" dia.			.185" dia.			.200" dia.		.260" dia.
XC209	Red	10/$1	XC526	Red	5/$1	XC556	Red	10/$1	MV50 - Red - 6/$1
XC269	Green	4/$1	XC526	Green	4/$1	XC856	Green	4/$1	
XC269	Orange	4/$1	XC526	Yellow	4/$1	XC856	Yellow	4/$1	
XC269	Yellow	4/$1	XC526	Orange	4/$1	XC556	Orange	4/$1	
	.200" dia.		XC526	Clear	4/$1	XC556	Clear	7/$1	
XC22	Red	10/$1							
XC22	Green	4/$1							
XC22	Yellow	4/$1							
XC22	Orange	4/$1							
SSL-STI	RT	4/$1							

XC111 Red 10/$1
XC111 Green 4/$1
XC111 Yellow 4/$1
XC111 Orange 4/$1

MRP50-RED LEDS
¾" x ¾" x 1/16"
Flat $.01 ea.

DISPLAY LEDS

DL707

TYPE	POLARITY	HT	TYPE	POLARITY	HT	
MAN 1	Common Anode	.270	2.95	MAN 3940	Common Cathode-orange	.300	1.75
MAN 2	5 x 7 Dot Matrix	.300	4.95	MAN 4710	Common Anode-Red	.400	1.95
MAN 3	Common Cathode	125 3/1.00		DL701	Common Anode-red ±	.300	.99
MAN 4	Common Cathode	.187	1.95	DL704	Common Cathode	.300	.99
MAN 7	Common Anode	.300	1.25	DL707	Common Anode	.300	.99
MAN 7G	Common Anode-green	.300	1.95	MAN 4740	Common Anode-Red	.400	.99
MAN 7Y	Common Anode-yellow	.300	1.95	DL741	Common Anode	.600	1.50
MAN 52	Common Anode-green	.300	.99	DL 747	Common Anode	.600	2.25
MAN 64	Common Anode-red	.400	.99	DL 750	Common Cathode	.600	2.49
MAN 74	Common Cathode	.300	1.50	DL 330	Common Cathode	.110	.50
MAN 82	Common Anode-yellow	.300	.99	FND70	Common Cathode	.250	.75
MAN 84	Common Cathode-yellow	.300	.99	FND503	Common Cathode	.500	1.00
MAN 3620	Common Anode -orange	.300	1.75	FND507	Common Anode	.500	1.00

DL333

FCS 8060A — 3½ Digit — .8" Display

NEW!! 25 Pin Version with colon & am/pm indicator

FRONT VIEW - FCS8060

SPECIAL $4.95 EA.

- MAXIMUM FORWARD CURRENT — 25 mA.
- Connects almost any display (except colon, 18 hrs. b & c and 10 min. a & d which are 16 mA.
- Forward voltage drop 1.5 volts.
- Typical segment current 5mA except colon, 18 hrs. b & c and 10 min. a & d which are 16 mA.

HP 5082-7300 Multi-Digit Series

- ⅜" Ht. • Common Cathode • Dip Package
- 3 to 5 volts @ 5 mils per segment
- 7 segment Monolithic • Red Display

2 Digit	$ .79
3 Digit	.89
4 Digit	.99
6 Digit	1.19

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	16	15	24 pin	$.38	37	35
14 pin	.20	19	18	28 pin	.45	44	43
16 pin	.22	21	20	36 pin	.60	59	58
18 pin	.29	28	27	40 pin	.63	62	61
22 pin	.37	36	35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	25	24	28 pin	$ .99	.93	.91
16 pin	.39	27	25	36 pin	1.30	1.26	1.15
18 pin	.35	32	30	40 pin	1.59	1.45	1.39
24 pin	.49	.45	42				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.39	27	24	24 pin	$ .79	.63	.57
14 pin	.35	32	29	28 pin	1.10	1.00	.99
16 pin	.39	35	32	36 pin	1.75	1.40	1.25
18 pin	.52	.47	43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	41	37	24 pin	$1.65	.95	.85
14 pin	.39	.38	37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	41	36 pin	1.59	1.45	1.39
18 pin	.75	.69	62	40 pin	1.75	1.55	1.49

50 PCS. RESISTOR ASSORTMENTS — $1.25 PER ASST.

SPECIAL

ASST. 1	5 ea.	10 OHM	12 OHM	15 OHM	18 OHM	22 OHM	1/4 WATT 5% - 50 PCS.
		27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	
ASST. 2	5 ea.	68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	1/4 WATT 5% - 50 PCS.
		180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	
ASST. 3	5 ea.	470 OHM	560 OHM	680 OHM	820 OHM	1K	1/4 WATT 5% - 50 PCS.
		1.2K	1.5K	1.8K	2.2K	2.7K	
ASST. 4	5 ea.	3.3K	3.9K	4.7K	5.6K	6.8K	1/4 WATT 5% - 50 PCS.
		8.2K	10K	12K	15K	18K	
ASST. 5	5 ea.	22K	27K	33K	39K	47K	1/4 WATT 5% - 50 PCS.
		56K	68K	82K	100K	120K	
ASST. 6	5 ea.	150K	180K	220K	270K	330K	1/4 WATT 5% - 50 PCS.
		390K	470K	560K	680K	820K	
ASST. 7	5 ea.	1M	1.2M	1.5M	1.8M	2.2M	1/4 WATT 5% - 50 PCS.
		2.7M	3.3M	3.9M	4.7M	5.6M	
ASST. 8R	Includes Resistor Assortments 1-7 (350 PCS.)						$7.49 ea.

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1977A Catalog
Dealer Discount Available — Request Pricing

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1021-A HOWARD AVE., SAN CARLOS, CA. 94070
PHONE ORDERS WELCOME — (415) 592-8097
All Advertised Prices Good Thru August

J1

WIRE WRAP CENTER

HOBBY-WRAP TOOL-BW-630

- Battery Operated (Size C)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)

Complete with built-in bit and sleeve

$34.95
(batteries not included)

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$11.95

WIRE WRAP TOOL WSU-30

WRAP • STRIP • UNWRAP - $8.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

Plastic Push Button Switch

- *18 AWG Solid Wire - 5" Long
- *.30 (solid) X .80 (high) ¼-27 Thread
- *8 AMP @ 14 Volt - 1 AMP @ .10 Volt

		1-9	10-Up
J-188-1	Push On-Push Off	.59	.49
J-188-2	Normally Open	.59	.49
J-188-3	Normally Closed	.59	.49

DIP SWITCHES

DPST Slide Action

#206-4	(8 pin dip)	4 switch unit $1.75 ea.
#206-7	(14 pin dip)	7 switch unit $1.95 ea.
#206-8	(16 pin dip)	8 switch unit $2.25 ea.

TV GAME CHIP SET — $14.95

Includes AY-3-8500-1 chip and 2.010 mhz crystal — If purchased separately would cost $18.95.

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400mw	4/1.00	1N4005	600 PIV 1 AMP		10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV 1 AMP		10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV 1 AMP		10/1.00
1N753	6.2	400m	4/1.00	1N34A	50	20mw	5/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N3589	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N4689	15	400m	4/1.00	1N4305	75	10m	30/1.00
1N5232	5.6	500m	2/1.00	1N4734	5.6	1w	2/1.00
1N5234	6.2	500m	2/1.00	1N4735	6.2	1w	2/1.00
1N5235	6.8	500m	2/1.00	1N4736	6.8	1w	2/1.00
1N5238	7.5	500m	2/1.00	1N4738	8.2	1w	2/1.00
1N456	25	400m	6/1.00	1N4742	12	1w	2/1.00
1N458	100	75m	6/1.00	1N4744	15	1w	2/1.00
1N4005A	600	1w	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.80
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

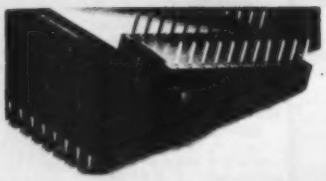
SCR AND FW BRIDGE RECTIFIERS

C35D	15A @ 400V	SCR	$1.95
C35M	35A @ 200V	SCR	1.95
2N2329	1.6A @ 200V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.55
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	5/$1.00	PN2907	3/$1.00
MPS A55	5/$1.00	PN2907A	4/$1.00
2N3053	4/$1.00	PN3565	4/$1.00
2N3231	4/$1.00	PN3566	4/$1.00
2N3553A	5/$1.00	2N3702	5/$1.00
2N3638	5/$1.00	2N3703	5/$1.00
2N3638A	4/$1.00	2N3704	5/$1.00
2N3640	4/$1.00	2N3705	5/$1.00
2N3642	4/$1.00	2N3706	5/$1.00
2N3643	4/$1.00	2N3707	5/$1.00
2N3644	4/$1.00	2N3711	5/$1.00
2N3645	5/$1.00	2N3724	5 .$1.00
2N3693	3/$1.00	2N3725	$1.00
2N3694	$ .60	2N3726	5/$1.00
2N3695	$ .60	2N3904	4/$1.00
2N3696	$ .60	2N3905	4/$1.00
2N3700	$1.25	2N3906	4/$1.00
2N3702	5/$1.00	2N3904	5/$1.00
2N3703	5/$1.00	2N4123	10/$1.00

PN4250	4/$1.00	2N5210	4/$1.00
PN4258	4/$1.00	2N5306	4/$1.00
PN4259	4/$1.00	2N5307	4/$1.00
PN4260	4/$1.00	2N5308	4/$1.00
PN4261	4/$1.00	2N5309	4/$1.00
PN4262	4/$1.00	2N5310	4/$1.00
PN4263	4/$1.00	2N5311	4/$1.00
PN4264	4/$1.00	2N5312	4/$1.00
PN4265	4/$1.00	2N5313	4/$1.00
PN4266	4/$1.00	2N5314	4/$1.00
PN4267	4/$1.00	2N5315	4/$1.00
PN4268	4/$1.00	2N5316	4/$1.00
PN4269	4/$1.00	2N5317	4/$1.00
PN4270	4/$1.00	2N5318	4/$1.00
PN4271	4/$1.00	2N5319	4/$1.00
PN4272	4/$1.00	2N5320	4/$1.00
PN4273	4/$1.00	2N5321	4/$1.00
PN4274	4/$1.00	2N5322	4/$1.00
PN4275	4/$1.00	2N5323	4/$1.00
PN4276	4/$1.00	2N5324	4/$1.00
PN4277	4/$1.00	2N5325	4/$1.00
PN4278	4/$1.00	2N5326	4/$1.00
PN4279	4/$1.00	2N5327	4/$1.00
PN4280	4/$1.00	2N5328	4/$1.00
PN4281	4/$1.00	2N5329	4/$1.00
PN4282	4/$1.00	2N5330	4/$1.00
PN4283	4/$1.00	2N5331	4/$1.00
PN4284	4/$1.00	2N5332	4/$1.00
PN4285	4/$1.00	2N5333	4/$1.00
PN4286	4/$1.00	2N5334	4/$1.00
PN4287	4/$1.00	2N5335	4/$1.00
PN4288	4/$1.00	2N5336	4/$1.00
PN4289	4/$1.00	2N5337	4/$1.00
PN4290	4/$1.00	2N5338	4/$1.00
PN4291	4/$1.00	2N5339	4/$1.00
PN4292	4/$1.00	2N5340	4/$1.00
PN4293	4/$1.00	2N5341	4/$1.00
PN4294	4/$1.00	2N5342	4/$1.00
PN4295	4/$1.00	2N5343	4/$1.00
PN4296	4/$1.00	2N5344	4/$1.00
PN4297	4/$1.00	2N5345	4/$1.00
PN4298	4/$1.00	2N5346	4/$1.00
PN4299	4/$1.00	2N5347	4/$1.00
PN4300	4/$1.00	2N5348	4/$1.00
PN4301	4/$1.00	2N5349	4/$1.00
PN4302	4/$1.00	2N5350	4/$1.00
PN4303	4/$1.00	2N5351	4/$1.00
PN4304	4/$1.00	2N5352	4/$1.00
PN4305	4/$1.00	2N5353	4/$1.00
PN4306	4/$1.00	2N5354	4/$1.00
PN4307	4/$1.00	2N5355	4/$1.00
PN4308	4/$1.00	2N5356	4/$1.00
PN4309	4/$1.00	2N5357	4/$1.00
PN4310	4/$1.00	2N5358	4/$1.00
PN4311	4/$1.00	2N5359	4/$1.00
PN4312	4/$1.00	2N5360	4/$1.00
PN4313	4/$1.00	2N5361	4/$1.00
PN4314	4/$1.00	2N5362	4/$1.00
PN4315	4/$1.00	2N5363	4/$1.00
PN4316	4/$1.00	2N5364	4/$1.00
PN4317	4/$1.00	2N5365	4/$1.00
PN4318	4/$1.00	2N5366	4/$1.00
PN4319	4/$1.00	2N5367	4/$1.00
PN4320	4/$1.00	2N5368	4/$1.00
PN4321	4/$1.00	2N5369	4/$1.00
PN4322	4/$1.00	2N5370	4/$1.00
PN4323	4/$1.00	2N5371	4/$1.00
PN4324	4/$1.00	2N5372	4/$1.00
PN4325	4/$1.00	2N5373	4/$1.00
PN4326	4/$1.00	2N5374	4/$1.00
PN4327	4/$1.00	2N5375	4/$1.00
PN4328	4/$1.00	2N5376	4/$1.00
PN4329	4/$1.00	2N5377	4/$1.00
PN4330	4/$1.00	2N5378	4/$1.00
PN4331	4/$1.00	2N5379	4/$1.00
PN4332	4/$1.00	2N5380	4/$1.00
PN4333	4/$1.00	2N5381	4/$1.00
PN4334	4/$1.00	2N5382	4/$1.00
PN4335	4/$1.00	2N5383	4/$1.00
PN4336	4/$1.00	2N5384	4/$1.00
PN4337	4/$1.00	2N5385	4/$1.00
PN4338	4/$1.00	2N5386	4/$1.00
PN4339	4/$1.00	2N5387	4/$1.00
PN4340	4/$1.00	2N5388	4/$1.00
PN4341	4/$1.00	2N5389	4/$1.00
PN4342	4/$1.00	2N5390	4/$1.00
PN4343	4/$1.00	2N5391	4/$1.00
PN4344	4/$1.00	2N5392	4/$1.00
PN4345	4/$1.00	2N5393	4/$1.00
PN4346	4/$1.00	2N5394	4/$1.00
PN4347	4/$1.00	2N5395	4/$1.00
PN4348	4/$1.00	2N5396	4/$1.00
PN4349	4/$1.00	2N5397	4/$1.00
PN4350	4/$1.00	2N5398	4/$1.00
PN4351	4/$1.00	2N5399	4/$1.00
PN4352	4/$1.00	2N5400	4/$1.00
PN4353	4/$1.00	2N5401	4/$1.00
PN4354	4/$1.00	2N5402	4/$1.00
PN4355	4/$1.00	2N5403	4/$1.00
PN4356	4/$1.00	2N5404	4/$1.00
PN4357	4/$1.00	2N5405	4/$1.00
PN4358	4/$1.00	2N5406	4/$1.00
PN4359	4/$1.00	2N5407	4/$1.00
PN4360	4/$1.00	2N5408	4/$1.00
PN4361	4/$1.00	2N5409	4/$1.00
PN4362	4/$1.00	2N5410	4/$1.00
PN4363	4/$1.00	2N5411	4/$1.00
PN4364	4/$1.00	2N5412	4/$1.00
PN4365	4/$1.00	2N5413	4/$1.00
PN4366	4/$1.00	2N5414	4/$1.00
PN4367	4/$1.00	2N5415	4/$1.00
PN4368	4/$1.00



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SKT-0802 8 pin	.15	.15	.14
1402 14pin	.18	.17	.16
1602 16pin	.20	.19	.18
1802 18pin	.27	.26	.25
2002 20pin	.29	.28	.27
2202 22pin	.35	.34	.33
2402 24pin	.36	.35	.34
2802 28pin	.42	.41	.40
4002 40pin	.60	.57	.53

3 Level Wire Wrap Gold

	1-9	10-24	25-100
SKT-1400	.38	.37	.36
1600	.42	.41	.40
1800	.73	.65	.59
2400	1.00	.91	.83
4000	1.69	1.51	1.37

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Highest quality 30 ga. Kynar insulated silver plated wire for wrapping. Stripped 1" on both ends. Indicated lengths are lengths of insulated portion. Packed 100 per sturdy plastic vial or 1000 per poly bag. Compare our prices!!!. Available in Black, Red, Yellow and Green. State color desired.

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2"	$1.60 (WW30VC-2)	$12.80 (#WW30BK-2)
4"	$1.85 (WW30VC-4)	$14.80 (#WW30BK-4)
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2" insulation, blue, bag of 100 pieces.....$1.19

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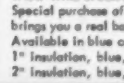

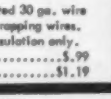

No. Of Pins	SINGLE END 6"	12"	18"	24"	36"	48"
14P	1.51	1.62	1.72	1.83	2.05	2.26
16P	1.64	1.76	1.87	1.99	2.21	2.44
24P	2.49	2.69	2.88	3.08	3.48	3.87
	DOUBLE END					
14P	2.76	2.87	2.97	3.08	3.30	3.51
16P	3.01	3.13	3.24	3.36	3.58	3.81
24P	4.55	4.75	4.94	5.14	5.54	5.93

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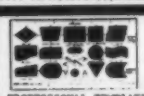

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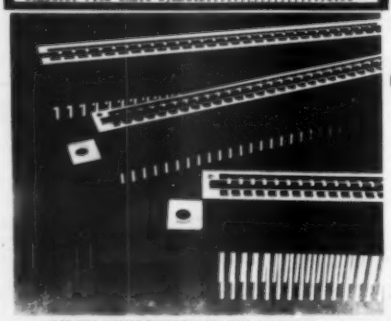
1/2 Size.....(Handy shirt pocket size).....$3.25
Computer Flow Chart Symbols.....$3.50



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2X50 with .125" spacing. Solder tail or wrap terminals. By TI.
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C106F2.. 50V, 4A SCR w/socket..... 3/$1
1N967B.. 18V, 5%, ½W Zener..... 5/$1
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.TTL compatability
.CMOS compatability (5V)
.Shifted character compatability
.Includes Greek alphabet
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(See article in March '77 issue of 73 Magazine for applications including TV-Computer interface)
MCM6571A..... $9.95
Specs..... $1.00

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Spec..... .30

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Digital alarm clock • Six big .5 display LEDs • New on board AC Transformer • 12 Hour format with 24 hour Alarm • Snooze Feature • Elapsed time indicator.
A natural for cars, campers and mobile homes. Use on 12 volt dc with optional crystal time base (not including cabinet)
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Optional cabinet — in simulated walnut grain or black leather $4.95
Plastic cabinets — blue, black, white or smoke $3.95

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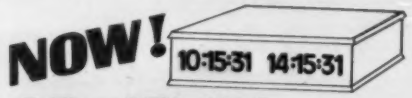
● STOPWATCH HAND CASE for above $3.95



2 Dual Digital 12-24 hour clock kits

MODEL ALD5:
Six big .5 display LEDs in an attractive black plastic cabinet with a red front filter. Great for a ham or broadcast station. Set one clock to GMT the other to local time. Or have a 24 hour format on one clock and 12 hour on the other. Freeze feature lets the clock be set to the second. Each clock is controlled separately. Cabinet measures 2¾" x 4¾" x 9¾". Complete Kit $44.95.

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7410	.20	7494	.95	74199	2.25	74LS191	2.85
7411	.30	7495	.90	74283	2.25	74LS193	2.85
7413	.85	7496	.85			74LS195	2.00
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7416	.45	74104	.45	74LS00	.39	74LS197	1.75
7417	.45	74105	.45	74LS02	.39	74LS257	1.75
7420	.25	74107	.50	74LS04	.45	74LS365	1.75
7421	.40	74121	.55	74LS08	.39	74LS366	1.75
7425	.45	74122	.60	74LS10	.39	74LS368	1.75
7427	.40	74123	1.05	74LS11	.39	74LS390	3.75
7430	.20	74125	.65	74LS20	.39	**74H SERIES**	
7432	.32	74141	1.25	74LS21	.39	74H00	.33
7437	.50	74145	1.25	74LS22	.39	74H01	.35
7438	1.05	74148	2.25	74LS30	.39	74H04	.31
7444	1.10	74150	1.10	74LS37	.45	74H10	.33
7445	1.10	74151	1.00	74LS38	.45	74H21	.33
7446	1.45	74153	1.35	74LS74	.65	74H30	.33
7447	.90	74154	1.70	74LS90	.95	74H40	.33
7448	1.15	74155	1.35	74LS93	.95	**74S SERIES**	
7450	.50	74156	1.35	74LS113	.79	74S04	.45
7451	.20	74157	1.35	74LS114	.65	74S40	.30
7453	.20	74160	1.35	74LS132	1.55	74S153	2.25
7454	.20	74161	1.45	74LS138	.45	74S158	2.00
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Digital clock kits

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$149. kit

Z-80 Chip & Manual $49.95

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Z-80 MANUAL – $7.50 SEPARATELY

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4K LOW POWER RAM BOARD KIT

Imsai and Altair 8080 plug in compatible. Uses low power static 21L02-1 500 ns. RAM'S. Fully buffered, drastically reduced power consumption, on board regulated, all sockets and parts included. Premium quality plated through PC Board.
For 250 ns RAM's add $10.00

Music to your Ears!

CAR/BOAT KIT
$34.95

NEWEST KIT FROM S.D. SALES!

MUSICAL HORN

HOME KIT
$19.95

Musical Horn Kit for Car, Boat or Home
Plays any tune from Mozart to Led Zeplin
Change tunes in seconds
Complete Solid State electronics
Standard or custom tunes available at $6.95 each
(you supply us with the sheet music – we supply electronics for your favorite tunes.)
One song supplied with original order

Standard Tunes Available:
DIXIE – EYES OF TEXAS – ON WISCONSIN – YANKEE DOODLE DANDY – NOTRE DAME FIGHT SONG – PINK PANTHER – AGGIE WAR SONG – ANCHORS AWAY – NEVER ON SUNDAY BRIDGE OVER RIVER QUI – CANDY MAN

Home Kit includes speaker which operates from your door bell. When door bell is pushed your favorite tune is played. Car/Boat Kit DOES NOT include speaker. Uses standard Sohm PM speaker. Allow 4 weeks delivery on both kits.

Limited Quantity!

$9.95 kit

SIX DIGIT ALARM CLOCK KIT

We made a fantastic kit even better. Redesigned to take advantage of the latest advances in I.C. clock technology. Features: Litronix Dual ½" displays. Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). For P.C.Board add $3.00; AC XFMR add $1.50. Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle – avoid the 5314!
NEW! WITH JUMBO LED READOUTS!

1000 MFD Filter Caps	SLIDE SWITCH Assortment	POWER RESISTOR	RESISTOR ASSORTMENT	P.C. LEAD DIODES		DISC CAP ASSORTMENT
Rated 35 WVDC Upright style with PC leads. Most popular value for hobbyists.	Our best seller. Includes miniature and standard sizes, single and multi-position units. All new.	15 OHM 25W BY CLAROSTAT	¼W 5% & 10% PC leads. A good mix of values! Special!	1N4148/1N914 100/$2.00	1N4002 - 1A 100 PIV	P.C. Leads. At least 10 different values. Includes .001, .01, .05 plus other standard values.
4/$1.00	12/$1.00	75¢ ea.	200/$2.	40/$1.	Just received a good mixed lot of National TO-92 plastic transistors. PNP & NPN, even a few FET's. 40-50% yield. Untested Asst. 500/$3.	60/$1.00

AMD-1702A

Huge Factory Purchase

FACTORY PRIME UNITS! BRAND NEW!
1.5 Micro-Seconds Access Time.
10/$40. $4.95 ea.

IC's from XEROX

7400 – 9c	7430 – 9c	7493 –26c	1402 A Shift Regulator – 50c
7402 – 9c	7440 – 9c	74121 –22c	MH0025CN – 55c
7404 – 9c	7437 –10c	74123 –32c	
7406 –11c	7438 –10c	74151 – 9c	IC's REMOVED FROM PC BOARDS ALL TESTED; FULL SPEC.
7407 –11c	7451 – 9c	74155 –22c	
7410 – 9c	7474 –16c	74193 –35c	
7416 –13c	7475 –24c	8233 – 35c	
7420 – 9c	7486 –16c	Intel – 1302 – 45c	

UP YOUR COMPUTER! 21L02-1

And so is power! Not only are our RAM'S faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02-1 Low Power and Super Fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off!

500 ns 8/$12.95
250 ns 8/$15.95

$12.95 *S.D. Sales Exclusive!* **$12.95**

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40 PIN DIP. Everything you ever wanted in a counter chip. Features: Direct LED sement drive, single power supply (12 VDC TYPE.), six decades up/down, pre-loadable counter, separate pre-loadable compare register with compare out-put, BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking. 1MHZ. count input frequency.
VERY LIMITED QUANTITY!

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28 PIN IC Sockets 3/$1.00

39 MFD 16V Mallory Electrolytic 15/$1.00

11,000 MFD 50WVDC Computer Grade Cap. $3.00

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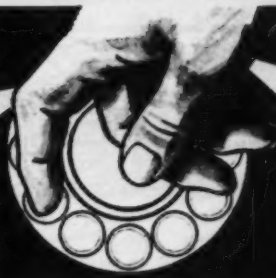

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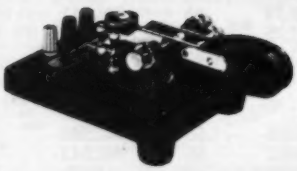
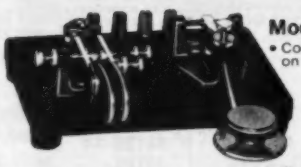


Model HK-1
- Dual-lever squeeze paddle
- Use with HK-5 or any electronic keyer
- Heavy base with non-slip rubber feet
- Paddles reversible for wide- or close-finger spacing

$29.95

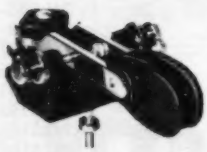


Model HK-4
- Combination of HK-1 and HK-3 on same base

$44.95

Terminals, red or black, $.75 each

- Base only with rubber feet **$12.00**



Model HK-2
- Same as HK-1 less base for incorporation in own keyer

$19.95

Model HK-5 Electronic Keyer
- Iambic Circuit for squeeze keying
- Self-completing dots and dashes
- Dot memory
- Battery operated with provision for external power
- Built-in side-tone monitor
- Speed, volume, tone and weight controls
- Grid block or direct keying
- For use with external paddle, such as HK-1

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Model HK-3
- Deluxe straight key
- Heavy base — no need to attach to desk
- Velvet smooth action

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Model HK-3A
- Same as above less base **$9.95**

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1N914	100v	10mA	.05
1N4004	400v	1A	.08
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.03
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.25
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.95
Molex pins .01		To-3 Sockets		.25
2 Amp Bridge		100-prv		1.20
25 Amp Bridge		200-prv		1.95

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2N2222	NPN			.15
2N2907	PNP			.15
2N3740	PNP	1A	60v	.25
2N3906	PNP			.10
2N3054	NPN			.35
2N3055	NPN	15A	60v	.50
T1P125	PNP	Darlington		.35
LED Green, Red, Clear				.15
D.L.747	7 seg 5/8" high com-anode			1.95
XAN72	7 seg com-anode			1.50
FND 359	Red 7 seg com-cathode			1.25

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4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	1.20
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.70
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.95
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	1.25
4044	.95
4046	1.50
4049	.80
4050	.60
4066	1.35
4069	.40
4071	.35
4082	.45

— T T L —

7400	.15	7473	.25	74176	1.25	74H72	.55
7401	.15	7474	.35	74180	.85	74H101	.75
7402	.20	7475	.35	74181	2.75	74H103	.75
7403	.20	7476	.30	74182	.95	74H106	.95
7404	.15	7480	.55	74190	1.75		
7405	.25	7481	.75	74191	1.35		
7406	.35	7483	.95	74192	1.65	74L00	.35
7407	.55	7485	.95	74193	.85	74L02	.35
7408	.25	7486	.30	74194	1.25	74L03	.30
7409	.15	7489	1.35	74195	.95	74L04	.35
7410	.10	7490	.55	74196	1.25	74L10	.35
7411	.25	7491	.95	74197	1.25	74L20	.35
7412	.30	7492	.95	74198	2.35	74L30	.45
7413	.45	7493	.40	74221	1.00	74L47	1.95
7414	1.10	7494	1.25	74367	.85	74L51	.45
7416	.25	7495	.60			74L55	.65
7417	.40	7496	.80			74L72	.45
7420	.15			75108A	.35	74L73	.40
7426	.30			75110	.35	74L74	.45
7427	.45	74100	1.85	75491	.50	74L75	.55
7430	.15	74107	.35	75492	.50	74L93	.55
7432	.30	74121	.35			74L123	.55
7437	.35	74122	.55				
7438	.35	74123	.55	74H00	.25		
7440	.25	74125	.45	74H01	.25	74S00	.55
7441	1.15	74126	.35	74H04	.25	74S02	.55
7442	.55	74132	1.35	74H05	.25	74S03	.40
7443	.85	74141	1.00	74H08	.35	74S04	.35
7444	.45	74150	1.00	74H10	.35	74S05	.35
7445	.80	74151	.75	74H11	.25	74S08	.35
7446	.95	74153	.95	74H15	.30	74S10	.35
7447	.95	74154	1.05	74H20	.30	74S11	.35
7448	.95	74156	1.15	74H21	.25	74S20	.35
7450	.25	74157	.65	74H22	.40	74S40	.25
7451	.25	74161	.85	74H30	.25	74S50	.25
7453	.20	74163	.95	74H40	.25	74S51	.45
7454	.25	74164	.60	74H50	.25	74S64	.25
7460	.40	74165	1.50	74H51	.25	74S74	.40
7470	.45	74166	1.35	74H52	.15	74S112	.90
7472	.45	74175	.80	74H53J	.25	74S114	1.30
				74H55	.25		

74S133	.45
74S140	.75
74S151	.35
74S153	.35
74S157	.80
74S158	.35
74S194	1.05
74S257(8123)	.25
74LS00	.45
74LS01	.45
74LS02	.45
74LS04	.45
74LS05	.55
74LS08	.45
74LS09	.45
74LS10	.45
74LS11	.45
74LS20	.40
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.40
74LS40	.55
74LS42	1.75
74LS51	.65
74LS74	.75
74LS86	.75
74LS90	1.30
74LS93	1.00
74LS107	.95
74LS123	1.00
74LS151	.75
74LS153	1.20
74LS157	.85
74LS164	1.90
74LS367	.85
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9309	.35
9322	.85
95H03	.55
9601	.75
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2102L-1	1.95
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8080AD	15.00
8T13	1.50
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8836	.95
MCT2	.95
8038	3.95
LM201	.75
LM301	.25
LM308 (Mini)	.75
LM309H	.65
LM309K(340K-5)	.85
LM310	1.15
LM311D(Mini)	.75
LM318 (Mini)	.65
LM320K5 (7905)	1.65
LM320K12	1.65
LM320T12	1.25
LM320T15	1.65
LM339	.95
7805 (340T-5)	.95
LM340T-12	1.00
LM340T-15	1.00
LM340T-18	1.00
LM340T-24	.95
LM340K-12	2.15
LM340K-15	1.25
LM340K-18	1.25
LM340K-24	.95
LM373	2.95
LM380	.95
LM709(8,14 PIN)	.25
LM711	.45
LM723	.50
LM725	1.75
LM739	1.50
LM741 8-14	.20
LM747	1.10
LM1307	1.25
LM1458	.95
LM3900	.50
LM75451	.65
NE555	.50
NE556	.95
NE565	.95
NE566	1.75
NE567	1.35
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From factory to you! Includes Fairchild FND-500 & 507's.

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"Hand clap" sensitizes crystal mike amplifier, triggers SCR. Cat. No. 8A3628

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Mfr unloads! Four 14-pin, four 16-pin. Solder tail, low-profile. No. 8A3621

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50 for $1.98
Unbelievable! Worth $50. High precision subminiature caps for all applications. Wt. 3 ozs. Cat. 8A 3520

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It's true! 20-key, 4 function keyboards at ridiculous give-away. Wt. 12 ozs. Cat. No. 8A 3524

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4" x 1" panels that glow blue-green with 110VAC. Use for nite lites, indicators, etc. Cat. No. 8A3530

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Includes resistors, caps, transformers, rectifiers, diodes, etc. for p.c. work. Professional, dumped into barrels by factories. 100% Cat. No. 8A 3401

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150 for $1.98
100% metal film resistors. Long leads. 8A3413

BARREL KIT #182 JUMBO RED LEDS
15 for $1.98
100% material, user cancellation from factory dumps, 3V 10 mils. For 100's of projects, red lens. Cat. No. 8A3360

BARREL KIT #163 MINI TRIM POTS
30 for $1.98
1 oz.
Asst. values 100 to 2 meg. What a buy. Single turn, ½ W. Wt. 6 oz. 8A3245

BARREL KIT #160 V. REGULATORS
10 for $1.98
No. 8A3350
LM309KC TO-3 V.R.'s barreled. Best by the pound.

BARREL KIT #159 MODULAR SWITCHES
25 for $1.98
Centralab switches, TV-makers excess. Dpdt, 6pdt, etc. Brand new. Cat. No. 8A 3150

BARREL KIT #154 CLOCK CHIPS
20 for $1.98
We gathered an assortment of clock chip, alarm, calendar, beepers, who knows, all mixed. Cat. No. 8A 3308

BARREL KIT #148 MINI TRANSFORMERS
15 for $1.98
outputs, interstage and audio. Only 1" sq. Wt. 2 lbs. 8A3294

BARREL KIT #144 RCA PHONO PLUGS
40 for $1.98
1,000,000 RCA phono plugs for this one. You hi-fi-ers know what they are
100% material. 8A3293

BARREL KIT #138 SLIDE SWITCHES
30 for $1.98
Did you hear of OAK? Another expt maker barrelled all types of rotaries, electric, slides, etc. 8A3245

BARREL KIT #135 MICRO MINI LAMPS
20 for $1.98
1 oz.
Imagine! Micro size (¼" x ¼") with wire leads. 3 to 8 VDC. 40 mils. 8A3289

BARREL KIT #134 MINI DIP ICs
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Large mfgr dumped 100's of lbs into barrels. Includes 741s, LM-380-8, 703, 567, 555, 558—but who knows? Wt. 1 lb. 8A3248 hobby

BARREL KIT #127 AXIAL ELECTROS
40 for $1.98
Asst. capacities and voltages. Cat. No. 8A3227

BARREL KIT #126 UPRIGHT ELECTROS
40 for $1.98
1mf to 300mf in mixture of voltages. 100% marked 'n good. 8A3236

BARREL KIT #115 MOLEX SOCKETS
100% good
200 for $1.98
Cat.No. 8A3144
Calculator maker dump! We got a zillion of 'em.

BARREL KIT #112 MICRO MINI LEDS
40 for $1.98
Hobby
All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50% or better. 8A3139

BARREL KIT #106 TERMINAL STRIPS
100 for $1.98
Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump in your gain. Wt. 1 lb. Cat.No 8A3136

BARREL KIT #104 SLIDE VOLUME CONTROLS
10 for $1.98
Cat.No. 8A1057

BARREL KIT #101 RESISTOR SPECIAL
200 for $1.98
Includes: ⅛, ¼, ½, 1, 2-watters, carbon. 5 oz. 100% good. 8A3054

BARREL KIT #99 PHOTO ELECTRIC CELLS
10 for $1.98
Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 150% good. Cat.No. 8A 3052

BARREL KIT #93 HALF WATTERS
200 for $1.98
Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value in there. 4 oz. 8A3046 Untested

BARREL KIT #91 SILVER MICAS
100 for $1.98
Axial, red case, variety of physical sizes & values. Cat.No. 8A 3018

BARREL KIT #84 LITRONICS LED READOUTS
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Hobby
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BARREL KIT #67 NATIONAL IC BONANZA
100 for $1.98
Types 8000, 7400 series, DTLs, ROMs, registers, clock & calc. chips, linears, etc. Cat.No. 8A 2960 Untested.

BARREL KIT #60 HOBBY LEDS
40 for $1.98
Wow! A Litronics dump of all kinds of mixed discrete LEDs. 8A3009

BARREL KIT #81 15 for $1.98 LM-340T VOLT REG
Factory rejected items too length of leads. May include ½, 6, 8, 12, 15, 18, 24 volts. Power tab. Cat. 8A 2835

BARREL KIT #81 SUBMINI RESISTORS
200 for $1.98
PC, upright type, color coded, ⅛ watt. Asst values. Came to us in a barrel. Cat.No 8A 2746 100% good

BARREL KIT #70 1-WATT ZENERS
100 for $1.98
Factory same as 400-mw's. Never-to-again offer. 6, 8, 10, 12, 15V, under glass. Double plug. Cat.No. 8A 2741 Untested.

BARREL KIT #73 TRANSISTOR ELECTROS
50 for $1.98
We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 8A2747

BARREL KIT #71 CAPACITOR SPECIAL
100 pcs. $1.98
micas, molded, plastics, ceramics, discs, etc. Nifty 100% good Cat.No 8A 2739

BARREL KIT #68 2 WATTERS
100 for $1.98
100% good.
Suppliers throw 'em in the barrel. It's a H'l gold mine. All marked. Cat.No. 8A 2735

BARREL KIT #65 MIXED READOUTS
10 for $1.98
Factory returns — much numbers as MAN-4's, MAN-7's, MAN-9's. 11 barrels & no time to separate. Hobby Cat.No. 8A 2733 Untested.

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100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat.No. 8A 2729

BARREL KIT #58 SLIDE SWITCHES
30 for $1.98
All shapes, sizes, spst, spdt, momentaries, etc. Tremendous shop pak for 100's of switching projects. Cat.No. 8A 2724 100% good

BARREL KIT #56 POWERS! POWERS!
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Cat. 8A 2724
Large distributor cleaned house. Barrels of power resistors 2 to 7 watts.

BARREL KIT #54 2 DIGIT READOUTS
10 for $1.98
Bargain of a lifetime! All we got was 1 barrel — the "blisdor digit" types. Multiplexed. Cat. No. 8A 2722

BARREL KIT #48 PNP HIGH-POWER TRANSISTORS
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Popular germanium TO-3 case 8A 2616 100% good

BARREL KIT #39 2N3055 HOBBY TRANSISTORS
15 for $1.98
Fallouts of the famous 2N3055. 8A 2617 100% good

BARREL KIT #36 GERMANIUM DIODES
Untested
200 for $1.98
Cat.No. 8A 2614
Famous maker, popular item. Never grown old.

BARREL KIT #38 NEON LAMPS
30 for $1.98 100% good.
Famous NE-2's. All prime, but factory made millions and barrel'ed 'em. Your advantage Cat.No 8A 2613

BARREL KIT #31 METAL OX. RESISTORS
100 for $1.98
Made mostly by Corning, the finest resistor made. Mostly ½ watters, 1% to 5% tols, & a barrel of values. Cat. No. 8A 2600

BARREL KIT #26 PREFORMED RESISTORS
200 for $1.98
We got barrels of ¼ and ½" watters for pc use. 100: ¼, 100 ½" watters.
No. 8A 2608 100% good

BARREL KIT #27 PREFORMED DISCS
150 for $1.98
Hi-Fi mfr's shelf inventory but he dumped 'em in barrels. Preformed, for PC use. Mixed values too! 8A 2609

KIT #26 PLASTIC TRANSISTORS
100 for $1.98
Hobby
Untested.
Type TO-92 (TO-18), all manufacturers, variety of 2N #'s. Cat. No 8A 2604

BARREL KIT #24 METAL CAN TRANSISTORS
100 for $1.98
Includes TO-5, TO-1, TO-18, etc., assorted 2N numbers, unmarked etc. Cat.No 8A 2603 Untested.

BARREL KIT #20 LONG LEAD DISCS
100 for $1.98
"suction sale" Prime, marked only. Long leads Cat.No 8A 2598 100% good

BARREL KIT #19 DIPPED MYLARS
60 for $1.98
Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. Cat.No. 8A 2597 100% good

BARREL KIT #14 PRECISION RESISTORS
200 for $1.98
Marked and unmarked ¼, ½, 2 watts. No 8A 2528

BARREL KIT #11 POWER TAB TRANSISTORS
40 for $1.98
NPN, plastic TO220 type. Assorted 2N numbers. No. 8A 2425 Untested.

BARREL KIT #10 ROMS-REGISTERS
75 for $1.98
Untested Hobby
2's to 40 pin devices, marked, internal factory numbers, etc Cat.No 8A 2424

BARREL KIT #8 SUBMINIATURE IF TRANSFORMERS
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Amazing, includes 455khz, osc, antenna, who knows? Cat.No. 8A 2422 100% good

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30 for $1.98 100% good
Singles, duals, variety of values, styles, big ones — small ones. Cat.No. 8A 2421

BARREL KIT #5 SCRS, TRIACS, QUADRACS
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Raw factory stock! All the 10 amp types. Cat.No. 8A 2419 Untested.

BARREL KIT #4 "4000" RECTIFIERS
100 for —
Untested.
1N4000 series. May include 2A, 50, 100, 200, 400, 600, 800 and 1000 volters. 8A 2417

BARREL KIT #3 1N4148/914 SWITCHING DIODES
100 for $1.98
Imagine various switching diodes at these prices! Cat.No. 8A 2418 Untested.

BARREL KIT #2 LINEAR OP AMPS, DIPS
75 for $1.98
Un-tested
May include 709's, 741's, 747's, 560 series, 556 includes 8A 2416 hobby

BARREL KIT #1 SN7400 DIP IC'S.
75 for $1.98
Marked 14 and/or with 16 pin dips, may include gates, registers, flip flops, counters, 8A 2415 Untest. Hobby

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Specifications
Ranges—DC Voltage: 0 to 15, 150, and 1000 V; AC Voltage: 0 to 15, 150, and 1000 V; Direct Current: 0 to 150 mA; Resistance: R x 1K (measures 100 Ω to 100 k Ω); Sensitivity—AC/DC: 1000 ohms-per-volt.
Battery, for ohms function (not supplied)—one 1.5 V penlite (RCA VB034A or equiv.).
Size and Weight—Dimensions: 3¾ in. (9 cm); 2⅝ in. (6 cm); 1⅜ in (3.4 cm); Weight: 5 oz. (142g). Cat. No. 8A3921

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1000 ohms per V.

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- Wide angle focusing lens!

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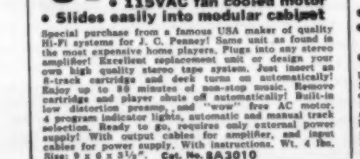

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Social Events

MACS INN ID
AUG 5-7

The 45th Annual WIMU (Wyoming, Idaho, Montana, and Utah) Hamfeast is scheduled to be held at Macs Inn, Idaho, just south of West Yellowstone (about 25 miles). This is one of the Rocky Mountain Northwest's largest hamfeasts. The registration fee for the 45th Annual WIMU Hamfeast will be $7 at the door. For further information, please contact Ronald Conley, General Chairman, WIMU Hamfeast, PO Box 30756, Billings, Montana 59107.

NEWBURGH NY
AUG 6

The Mt. Beacon Amateur Radio Club will hold their 4th Annual Hamfest on Saturday, August 6th, 9 am to 5 pm, at Stewart Field, Newburgh NY, inside hangar. Flea market and auction. Talk-in on 37/97 and 16/76. Rain or shine. Plenty of free parking. Admission $1, tailgating $1, under 12 free.

OKLAHOMA CITY OK
AUG 6-7

The 1977 Oklahoma Ham-Holiday will be held August 6 and 7, 1977 at the Southgate Inn Best Western, 5245 South Interstate 35, Oklahoma City, (405) 672-5561. Pre-registration $3.00, at the door $4.00.

JACKSONVILLE FL
AUG 6-7

The Bold City Hamfest sponsored by the Jacksonville Range Association will be held at the Jacksonville Beach Auditorium August 6-7. Vacation at our Hamfest — Florida's Friendliest. Visit our special "Solar" and "QRPp" forums. Send request for information and tables to Hamfest Coordinator, Jacksonville Range Association, PO Box 10623, Jacksonville FL 32207. For motel reservations call Ramada Inn toll free (800) 228-2828.

WASHINGTON MO
AUG 7

The Zero-Beaters ARC will hold their annual Hamfest on Sunday, August 7, 1977 at Washington, Missouri city park. Free parking, bingo, and many prizes. No admission fee or fee for parking in the trader's row. For info or tickets contact Marvin Holdmeyer WB0VPF, or Zero-Beaters ARC WA0FYA, Box 24, Dutzow MO 63342.

BERRYVILLE VA
AUG 7

The Shenandoah Valley Amateur Radio Club of Winchester, Virginia, will hold its annual Hamfest on August 7, 1977, at the Ruritan Fairgrounds, one mile west of Berryville, Virginia, on Business Rt. 7. Admission $1.50, tailgating or table $5.00. Free bingo, lots of great prizes, craft displays for the ladies and manufacturers' exhibits, refreshment stands and famous Ruritan chicken barbecue dinners. Grounds open at 8 am. The annual banquet will be held on August 6 beginning at 6:30 pm in the Pagoda Room of Duffs Rebel Restaurant on Millwood Avenue across from the National Guard Armory in Winchester VA. Admission $7 at door or write SVARC, P.O. Box 139, Winchester VA 22601.

FORT WAYNE IN
AUG 7

The Original FM Hamfest will be held Sunday, August 7, 1977, rain or shine, at the Allen County Police Reserve Center, 3022 Easterday Road, Fort Wayne, Indiana. 5400 square feet of air conditioned exhibit area, hot food and refreshments and prizes. Sponsored by Fort Wayne Repeater Association, Inc. Advanced registration $1.50 — call in to WA9EAU on 146.16/146.76, WR9ADI 146.52 or 52.525 MHz. Tickets at door $2.00. Taped route information available on 146.91 MHz. For more information and advance tickets please write: Fort Wayne Repeater Association, Inc., PO Box 6022, Fort Wayne IN 46806.

PITTSBURGH PA
AUG 7

The 40th Annual Hamfest of the South Hills Brass Pounders and Modulators will be held on August 7, 1977 from noon until dusk at St. Clair Beach, Upper St. Clair Township, 5 miles south of Mt. Lebanon, on Rte 19. Swap and shop, picnic space and swimming for the family. Mobile check-in on 29.0 and 146.52. Information and pre-registration at $1.50 per ticket ($2 at door) from Rich Eckenrode, 1410 Bellaire Pl., Pittsburgh PA 15226. Vendors must register.

LEVELLAND TX
AUG 7

The 12th annual West Texas Emergency Net Picnic and Swapfest will be held in the city park, Levelland, Texas on Sunday, August 7. Bring your own picnic basket. Registration begins at 8 am. Lunch at 12:30. Swapping all day. Tables are provided. This family event is jointly sponsored by the Hockley County Amateur Radio Club and the West Texas Emergency Net. Mobile talk-in frequency is on 2 meters only, on 28/88, the Levelland Repeater (WR5AFX). Prizes will be given this year and a $2 donation will be appreciated, but is not required for registration.

EWING TOWNSHIP NJ
AUG 7

The East Coast VHF Society and the Trenton State College Radio Club will be sponsoring a hamfest on August 7, 1977, at 10:00 am, at Trenton State College, Ewing Township NJ. Featured at 11:00 am will be the eleventh annual antenna measuring contest, on 432, 1296, and 2304. For further information, write Paul Wade WA2ZZF, 153 Woods Rd., Somerville NJ 08876, or Allen Katz, Dept. of Engineering Technology, Trenton State College, Trenton NJ 08625.

ANGOLA IN
AUG 7

The Steuben County Radio Amateurs presents the 19th Annual FM Picnic and Hamfest to be held on Sunday, August 7, 1977, at the Steuben County 4-H Park, approximately 2 mi. west and 2 mi. north of Angola, Indiana. Hamfest includes picnic-style B.B.Q. chicken and refreshments, inside tables for exhibitors and vendors, overnight camping permitted in park for those desiring to arrive Saturday, movies Saturday night, as usual. Tickets $1.00 by donation, advance registration not necessary. Talk-in frequencies 52.525, 146.52, 223.5, 446.0.

CANTON OH
AUG 7

The Canton, Ohio, Hall of Fame Hamfest (an official ARRL hamfest) will be held at the Stark County Fairgrounds on Sunday, August 7, 1977. Hamfest includes ARRL, Amateur Electronic Supply, Ken-Mar Industries, Omar Electronics, flea market, YL activities including games and drawings. Admission $3 at gate, $2.50 advanced. Under 13 years of age free. For advanced reservations contact: Butch Lebold WA8SHP, Box 3, Sandyville OH 44671. Advanced deadline July 30, 1977. For directions and information call: W8ZX on 146.19/79 (WR8ADE) or W8AL on 146.52/52. Mobile check-in prize!

AMARILLO TX
AUG 12-14

The Panhandle Amateur Radio Club of Amarillo, Texas, is sponsoring the 1977 Edition of the Golden Spread Hamfest at the Holiday Inn West, Amarillo, Texas, August 12, 13 and 14. A grand prize and pre-registration prize worth over $800 will be given away. Activities include six big tech and info sessions, commercial exhibitors, flea market, free bingo for all, two hospitality hours, live entertainment, special activities for the ladies, and demonstrations. Pre-registration $3, at the door $4. Write Golden Spread Hamfest, PO Box 10221, Amarillo, Texas 79106 for pre-registration packet.

POLSON MT
AUG 13

Western Montana amateurs will sponsor an annual Mini-Hamfest on Flathead Lake, near Polson, Montana, on August 13, 1977.

RENO NV
AUG 13

The 1977 Sierra Hamfest will be held on Saturday, August 13, 1977. Program includes: guest speakers, prizes, luncheon buffet, swap tables, QSL design contest, ladies' prizes, new equipment displays, WCARS station, swimming pool, kids' playground, rag chewing, oldest and youngest ham. Adult tickets $11 ($12 after Aug 1), ages 7 through 16 $4 ($5 after Aug 1), 6 and under free. For information or assistance, talk-in on 7255 or 146.94 simplex.

BRISTOL TN-VA
AUG 13-14

The Bristol Amateur Radio Club, Inc., will hold the Bristol Hamfest August 13-14 at the Beacon Drive-In Theatre on Blountville Hwy., 9 am to 5 pm, Saturday, 9 am to 3 pm Sunday. Tickets $1, flea market space $2. Talk-in on 01-61, 28-88 and 3980. Contact Bristol Amateur Radio Club, Paul E. Booher WA4KAS, 1221 Jonesboro Road, Bristol VA 24201.

CHARLOTTE VT
AUG 13-14

Burlington A.R.C. International Field Day will be held on August 13 and 14, 1977, at Charlotte, Vermont. Flea market both days 7 am Saturday to 5 pm Sunday. $3.00 early bird registration. $3.50 at door — write P.O. Box 312, Burlington, Vermont. Talk-in .01-.61.

FLOURTOWN PA
AUG 14

The Mt. Airy VHF Radio Club, Inc. (the Pack-Rats) will hold their annual picnic and family day on August 14, 1977, at the Ft. Washington State Park in Flourtown, Pennsylvania. Come renew friendships and talk to the hams of the Colombian Moonbounce Expedition. Time: 9 am to 4 pm. Registration $2 per family. Talk-in 146.52 and 52.525 simplex and 16/76.

PLAIN CITY OH
AUG 14

Union County Amateur Radio Club proudly presents Hamfest 77 to be held on Sunday, August 14, 1977 at Plain City Fairground near Columbus OH on St. Rt. 42, 4 miles south of 33. Hamfest includes large flea market, indoor tables for dealers, food available, free parking, and free overnight camping. Admission $1.50 advance, $2.00 at gate. Talk-in on 146.16/76. Check in (for prize) on 146.52. For more information write: Union County Amateur Radio Club, 13613 U.S. 36, Marysville OH 43040.

LEXINGTON KY
AUG 14

The Bluegrass Hamfest will be held August 14, 1977 at the Lexington National Guard Armory adjacent to the Bluegrass Field on Airport Road, Lexington, Kentucky. Grand prizes and door prizes will be given away. There will also be an indoor/outdoor flea market. Talk-in 146.16-76. Admission is $2.50 advance, $3.00 at door (includes grand prize stub). Doors open at 8 am. For more information and advance tickets write: Bluegrass Hamfest, Box 4411, Lexington, Kentucky 40504.

WILLOW SPRINGS IL
AUG 14

The Hamfesters' 43rd Annual Picnic and Hamfest will be held Sunday, August 14, 1977, at Santa Fe Park,

91st and Wolf Road, Willow Springs, Illinois, Southwest of Chicago. Exhibits for OMs and XYLs, famous Swappers Row. Ticket donation at gate $2.00, advance $1.50. For advance tickets send check or money order to Bob Hayes W9KXW, 18931 Cedar Ave., Country Club Hills IL 60477.

RIPLEY WV
AUG 14

The Jackson County Amateur Radio Club is pleased to announce the Cedar Lakes Hamfest on August 14, 1977. There will be a flea market as well as space for commercial displays available inside. The hamfest is located 3 miles off I77 at Ripley WV, at the site of the Arts and Crafts Fair. Talk-in on 146.52 as well as 31/91. The call is WD8JNU. For more information contact WB8TJA, PO Box 631, Ravenswood WV 26164 or call (304) 273-3190.

ST. CLOUD MN
AUG 14

The Saint Cloud Radio Club Annual Hamfest will be held on Sunday, August 14, 1977 from 10:00 am till closing, at the Sauk Rapids Municipal Park. Free parking and overnite parking, hot dogs and pop and chile available. Swapfest and ham gear sale. Talk in on 34/94 and 3925. For further information, contact Bill Zins WAØOTO, R.R. #4, St. Cloud MN 56301.

STURGIS SD
AUG 20

The Signal Hill Amateur Radio Club of the Northern Black Hills area will hold a Ham Flea Market from 10 am to 6 pm on August 20, 1977, at the South Sturgis Church of Christ, Sturgis SD. Talk-in on 52/52. For more information contact Dennis Painter WBØFYG, Box 759, Sturgis SD 57785, phone (605) 347-3087.

WHITNEYVILLE PA
AUG 20

The 1st Annual Tioga County, Pennsylvania, Hamfest will be held on Saturday, August 20, 1977, at the Tioga County Fairgrounds in Whitneyville, Route 6, 6 miles west of Mansfield PA, 5 miles east of Wellsboro PA. Programs include: Novice and beginner interest, space communications, FM and repeater forum, flea market area — free and large, open and covered. Admission $2 — unlicensed XYLs and harmonics free — CBers welcomed. Talk-in WR3AHN 146.19/79 . . . CB channel 5 simplex .52. Sponsored by the Tioga County Amateur Radio Club. For more information contact Denny Voorhees WA3FWQ, RD 2, Box 117A, Millerton PA 16936.

EL PASO TX
AUG 20-21

The El Paso Hamfest and Swapmeet will be held on Saturday, August 20 and Sunday, August 21 at the Mesa Inn Motel (take Interstate 10 to Executive Center exit). Saturday will feature registration, seminars, ladies' activities and banquet with a guest speaker. Sunday will feature an all day swapmeet. There will be door prizes as well as a pre-registration prize. Registration fees are: hamfest/swapmeet only — $8/head, $14/couple; swapmeet only — $2/head; total package (hamfest, banquet, swapmeet) $15/head, $25/couple. No registration necessary for children under 15. For more information write El Paso Hamfest, PO Box 4573, El Paso TX 79914.

STANTON DE
AUG 21

The 1977 Delmarva Hamfest will be held August 21, 8 am to 4 pm, rain or shine, at the Delaware Technical Community College in Stanton, Delaware. Take the Stanton-Delaware Park Exit off I-95. Tickets $2 advance, $2.50 at gate. Tailgating and tables $2.50. Door prizes and refreshments. Talk-in on 13/73, 146.52, and 3905. Contact John Low K3YHR, 11 Scotsfield Drive, Newark DE 19713.

DECATUR AL
AUG 21

The North Alabama Hamfest will be held Sunday, August 21 at Calhoun Community College in Decatur, Alabama. For information write North Alabama Hamfest Association, PO Box 9, Decatur, Alabama 35602.

WARREN OH
AUG 21

The Warren Amateur Radio Association will hold their hamfest on August 21, 1977 at the Trumbull KSU Branch, Route 45 at Warren Outerbelt. Best site ever. Bigger flea market, all closed-in parking; parks, lakes nearby. $2 registration. Details? QSL: Hamfest, Box 809, Warren OH 44482.

LAFAYETTE IN
AUG 21

The Seventh Annual Lafayette, Indiana Hamfest sponsored by the Tippecanoe Amateur Radio Association will be held Sunday, August 21, 1977 at the Tippecanoe County Fairgrounds, 18th Street and Teal Road (Indiana Highway 25), Lafayette IN. Tickets are $2 either by mail or at gate. You must purchase tickets by mail to be eligible for pre-registration prize. Send check or money order with SASE to Bill Bayley WA9ZDI, 1021 Beck Lane, Lafayette IN 47905 for tickets by mail. Last date for mail order purchase is August 12. The Indiana Radio Club Council meeting and presentation of awards will be in the afternoon. An Emergency Forum with Bruce W9UMH will be held from 10 am until noon. Bingo for XYLs. Free coffee and donuts early Sunday morning. No additional charges for flea market operators other than regular entrance ticket. Talk-in on repeater 146.13-146.73 and simplex 146.94. Club call is W9REG.

DESOTO IL
AUG 22

The SARS Hamfest will be held on August 22, 1977, in Desoto, Illinois. Program includes prizes, food, auction. No charge for flea merchants. For more information write Nick Koeningstein, 2009 Gray Dr., Carbondale IL 62901.

MARSHALLTOWN IA
AUG 28

The Iowa 75 Meter Phone Net will hold its Annual Ham Feast and Picnic Sunday, August 28, 1977, in Riverside Park in Marshalltown, Iowa. A pot luck meal will be held at noon with a short program and a few small prizes to be given away.

O'FALLON MO
AUG 28

The St. Charles Hamfest will be held August 28, 1977 at Diermanns Lake, 4 miles south of O'Fallon MO on Hiway K. This annual event will be bigger and better with improved facilities. Prizes, flea market, dealers, refreshments and plenty of parking. Tickets still $1.00. For advance info or tickets send SASE to: Dan Corbin, 1512 Sundowner, St. Charles MO 63301.

OAKLAND NJ
AUG 28

The 550 Amateur Radio Club Fleamarket will be held Sunday, August 28, 1977, 9 to 5 pm at the Oakland American Legion Hall, Oak Street, Oakland, New Jersey, rain or shine. Admission $1, tables $3, tailgate $2. Dealers invited. Beverages available. Talk-in WR2AHD, 146.49-147.49, 146.52. For further information contact 550 A.R.C., PO Box 364, Oakland NJ 07436 or call Rick Anderson WB2QOQ (201) 684-8569.

SPRINGFIELD MO
AUG 28

The Southwest Amateur Radio Club is having its annual Hamfest and picnic at Lake Springfield, just south of Springfield, Missouri on August 28, 1977. For more info write Southwest Missouri Amateur Radio Club, Inc., Drawer B, Glenstone Station, Springfield MO 65804.

LAPORTE IN
AUG 28

The LaPorte County Summer Electronic Swapfest will be held on Sunday, August 28th, at the County Fairgrounds in LaPorte, Indiana, 50 miles southeast of Chicago. Paved midway and indoor booths available at no charge. Good food and cold drinks available. Talk-in 37-97, 01-61, or 52 simplex. Tickets $2 at gate. More information from PO Box 30, LaPorte IN 46350.

ROLLAG MN
SEPT 2-5

The Western Minnesota Steam Threshers reunion will be held in Rollag, Minnesota, Sept. 2-5, 1977. Featured will be amateur special events station WMØSTR. Plans are being made for operation of CW and SSB on 80 through 10 meters, and possibly on 6 meters. QSL certificate will be sent upon verification of the log and receipt of an SASE. Send to: WBØLRK, PO Box 596, Fertile MN 56540.

OAKWOOD GA
SEPT 18

Lanierland ARC will hold its fourth annual "Hamnic" at the Lanier Islands Dogwood Pavilion on September 18, 1977. Two large covered pavilions and large parking area for swap shop and exhibits. Food available. No entry fee for Hamnic; however, Lanier Islands charges $2.00 entry fee per car. Picnic, hiking, and swimming for the kids. First prize IC-22S. Many other prizes. Talk-in on W4IKR/4 on 3975 and .07/.67. For further information, write Terry Jones WB4FMJ, Route 1, Box 298, Oakwood, Georgia 30566.

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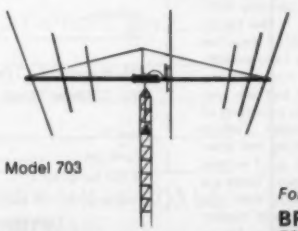

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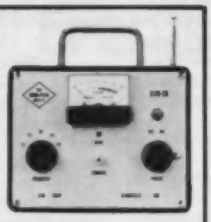

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You want to know about hardware? Read about the new MITS Z-80 CPU in Kilobaud, simply explained by the chap who designed the circuit. Or how about the best-selling TDL Z-80 CPU . . . the designer has written about it in Kilobaud too. You're wondering about what cassette system to use? You can go crazy on this one . . . but before flipping out, read the Hal Walker article in Kilobaud and find out what the problems are . . . and the solutions.

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● **CHEMISTRY WITH A COMPUTER** by Paul A. Cauchon. An exciting new chemistry book which contains a collection of tutorial, simulation and problem-generation computer programs. Tutorials provide individualization of assignment, immediate evaluation of responses and a new set of problems with each run. Simulations provide models of lengthy laboratory experimentation beyond the limited classroom timeframe and enhancement of course studies by encouraging pre-laboratory research. Problem-generating programs provide individualized sets of questions on a given topic. Can be used with almost any chemistry course at the high school or college level. All programs are written in BASIC, the most popular and easiest to learn educational programming language. $9.95.

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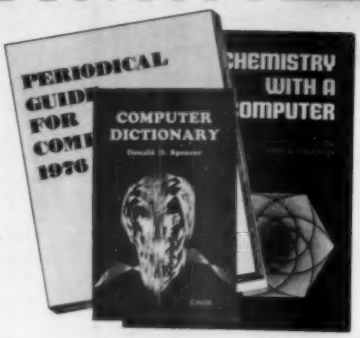

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● **PERIODICAL GUIDE FOR COMPUTERISTS** This is a 20 page book which indexes over 1,000 personal computing articles for the entire year of 1976 from Byte, Creative Computing, Digital Design, Dr. Dobbs Journal, EDN, Electronic Design, Electronics, Interface Age, Microtrek, Peoples Computer Company, Popular Electronics, QST, Radio Electronics, SCCS Interface and 73 Amateur Radio. Articles are indexed under more than 100 subject categories. Price $2.50.

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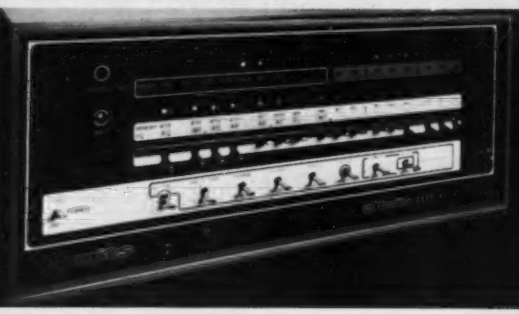

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See dozens of microcomputer systems on display and running . . . sit down and give them a try . . . find out why people get hooked on Star Trek . . . find out why 100,000 computermaniacs have gone nuts over microcomputers. See a couple of hundred exhibits of computers, memory boards, printers, floppy disks – see it all at the Pier this August!

Hear top computerized hams explain about the fun they are having and the fun you can have. This show is worth the trip from anywhere. Charter flights are being organized from the West Coast and Japan.

See the manufacturers show and tell about their systems . . . and answer your questions – in detail. You don't have to be a computer expert to find out how exciting microcomputers are . . . and why they are going to be a multi-billion dollar business before long. One look will convince you.

See Morse code translated into print . . . even into voice . . . all by microcomputer . . . and at a price within reasonable hobby limits. See Oscar data computers . . . repeater control computers . . . all sorts of fantastic ham applications of microcomputers.

Don't miss the fun at the Pier in Boston . . . where calculators . . . TV Games . . . Microcomputers . . . Hobby computer systems . . . ham computer systems . . . and even small business computers you may be able to use in your business will be on display and running for you to try out.

See a $250 computer which will beat you at chess . . . they come in all prices, from under $100 up to the sky!

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The NEW calculators do a lot . . . even have memory . . . will play lunar landing games . . . see them at the Pier!

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73–8

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The back issues of 73 are a gold mine of interesting articles . . . just take a look at what's been covered . . . every possible interest. This is the most important library you can have for hamming.

The supply of these back issues is very limited . . . and when these are gone, that will be it. Don't miss out by procrastinating.

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Twenty-five back issues (your choice) $20 postpaid in US.
Twenty-five back issues (our choice) $10 postpaid in US.

JUNE 63. Surplus issue: DMO-2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 band-spread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor-tuning, transistor cw monitor, BC-442 ant relay conversion, mobile loading coils, increasing Two-er selectivity, TV with the ART-26 tx, TRC-8 rx on 220, ARC-5 hf rx & tx, ARC-3 tx on 2M.

AUG 63. Battery op 6M stn, diode noise gen, video modulation, magic T-R switch, ant gain, halo mods, cw breakin, VEE beam design, coax losses, RF wattmeter, TX Tube Guide, diode pwr supply, "Lunchbox" squelch, SWR explanation, vertical ant info, info on Windom ant.

OCT 63. WBFM transceiver ideas, HF propagation, cheap tone patch, remote-tuned Yagi, construction hints, ant coupler, $5 Vertical, filament xformer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mike amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad issue: 432 Quad-quad-quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half-quad, three el quad, 20M quad, tiltover quad, easy-to-erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "dB," HF SSB/cw rx, geometric circuit design, GBB-201 transceive, FET converter for 10-20M, hi-pass rx filters.

JULY 67. VE ham radio, VE9 hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, 6AZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S-Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodics, rotatable dipole, gamma-match cap, old-time dxing, modern dxing.

JUNE 68. Surplus issue: Transformer tricks, BC-1206 rx, APS-13 ATV tx, low voltage dc supply, surplus scopes, FM rig commercial xtal types, Wilcox F-3 rx, restoring old equipment, 75A1 rx mods, TRA-19 on 432, freq counter use, transceiver pwr supply, uses for cheap tape recorders, Surplus Conversion Bibliography, RT-209 walkie on 2M, ARC-1 guard rx, RTTY tx TU.

JULY 68. Wooden tower construction, tiltover towers, erecting a telephone pole, IC AF osc, "dB" explained, ham club tips (Part 1).

SEPT 68. Mobile vhf, 432 FET preamps, converting TV Tuners, xtal osc stability, parallel-Tee design, moonbounce rhombic, 6M xciter (corrections Jan 69), 6M transceiver (corrections Jan 69), 2M dsb amp, ham club tips (Part 3).

NOV 68. SSB xtal filters, solid state troubleshooting, IC freq counter (many errors & omissions), "cw" transformers, space comm odyssey, pulser info, thin-wire ants, 40M transistor cw tx/rx, BC-348M rx, double-conversion, multifunction tester, copper wire specs, thermistor applications, hi-voltage transistor list, ham club tips (Part 5).

JAN 69. Suppressor compressor, HW-12 on 160, beam tuning, AC voltage control, 2M transistor tx, LC power reducer, spectrum analysis info, 6M transistor rx, operating console, RTTY autostart, calculating osc stability, lo-pwr 40 cw tx, sequential relay switching, sightless operator's bridge, ham club tips (Part 7).

FEB 69. SSTV camera mod for fast-scan, tri-band linear, selective af filter, unijunction transistor info, Nikola Tesla biography, mobile installation hints, extra-class license study (Part 1).

MAR 69. Surplus issue: TCS tx mods, cheap compressor/amp, RXZ calculations, transistor keyer, better balanced modulator, transistor oscillators, using blowers, halfwave feedline info, Surplus Conversion Bibliography, extra license study (Part 2).

APR 69. 2-channel scope amp, rx preamp, Two-er PTT, variable DC load, SWR bridge, 100 kHz marker gene, some transistor specs, SB-610 monitorscope mods, portable 6M AM tx, 2M converter, extra license study (Part 3).

MAY 69. 2M Turnstile, 2M Slot, rx attenuator, generator filter, short VEE, quad tuning, using antennascope, measuring ant gain, phone patch regs, SWR indicator, 160M short verticals, 15M antenna, HF propagation angles, PSK exciter, KW dummy load, hi-power linear, extra license study (part 4), all-band curtain array.

JUNE 69. Microwave pwr generation, 6M sb tx, 432-er tx/rx, 6M converter, 2M 5/8 wave whip, UHF tv tuners, ATV video modulator, UHF FET preamps, RTTY monitorscope, extra license study (part 5), building uhf cavities, mini-VEE for 10-20M, vhf vfo.

JULY 69. AM modulator, SSTV sig gen, 6M kw linear, 432 KW amp, 432-er tx/rx, 6M IC converter, radio-controlled models, RTTY IC TU, audio notch filter, VRC-19 conversion, tube substitution, 2M transistor xciter, extra license study (part 6), hf FET vfo.

AUG 69. FET regen for 3.5 MHz up, FM crystal switching, 5/8 wave vertical, introduction to ICs, RTTY tone gen, good/bad transistor checker, 2M AM tx, measure transistor Ft, 160M propagation, triac applications, simple IF sweep gen, transistor keyer, SB-100 on 6M, xtal freq measurement, extra license study (part 7), FM deviation meter, qrp am 6M tx, circular quads, FM noise figure, transistor parameter tracer.

SEPT 69. Tunnel diode theory, majic tee, soldering techniques, wave travel theory, cable shielding, transistor theory, AM noise limiter, AFSK gen, transistor amp debugging, measure meter resistance, diode-stack pwr supply, transistor testing, 2½W 6M tx, HX-10 neutralizing, capacitor useage, radio propagation, AM mod percentage, extra class license study (part 8), 3-400Z linear, ATV vidicon camera, 2 transistor testers, FET compressor, rf plate choke.

OCT 69. Super gain 40M ant, FET chirper, telephone info, scope calibrator, thyrector surge protector, slower tuning rates, identify calibrator harmonics, FM adaptor for AM tx, CB sets on 6M, proportional control xtal oven, xtal filter installation, Q-multiplier, transceiver pwr supply, extra class study (part 9).

NOV 69. NCX-3 on 6M, IF notch filters, dial calibration, HW32A external VFO, 6M converter, feedline info, rf z-bridge, fm mobile hints, umbrella ant, 432-er tx (part 1), pwr supply tricks with diodes, transistor keyer, transistor bias design, xtal vhf sign gen, electronic varlac, SB33 mods, extra class study (part 10), SB34 linear improvements.

DEC 69. Transistor-diode checker, dummy load/attenuator, tuned filter chokes, band-switching Swan 250 & TV-2, 88mh selectivity, match exercizes, rtl xtal calibrator, transistor pa design, hv mobile p.s., 1-10 gHz freqmeter, CB rig on 6M, extra license study (part II), 1970 buyer's guide.

JAN 70. Transceiver accessory unit, bench power supply, SSTV color method, base-loaded center-loaded ant, 6M bandpass filter, extra license study (part 12, rectifier diode useage, facsimile info.

FEB 70. 18-inch 15M dipole, 6M converter, high-density pc board, camper-mobile hints, 2M freq synthesizer, encoding/decoding for repeaters, DX-35 mods, panoramic vhf rx, variable-Z HF mobile mount, extra license study (part 13), linear IC info, qrp 40M tx, IC Q-multiplier.

MAR 70. Gdo applications, charger for drycells, FM freq meter, pc board construction, hem fm standards, cheap rf wattmeter, multifreq fm osc, "IF" system modules (part 1), Six-er mods, gdo dip lite, Motorola 41V conversion, cw monitor, buying surplus logic, SBQ-23A sonobuoy conversion, GRC-9 rx/tx conversion, extra class study (part 14), intro to vhf fm.

APR 70. Noise blanker, 2M hotcarrier diode converter, repeater controller, understanding COR repeater, 7/8-wave 2M ant, extra class study (part 15), inexpensive semiconductors, removating surplus meters, linear amp bias regulator, hi performance rf amp & agc system, SSB info for shortwave radio, vacuum tube load box, general fm dope & repeater guide, megger-ing your ant.

MAY 70. Comments on "fm docket" #18803, future of cw, fm-am rx alignment, 5/8 wave verticals, using 2M intelligently, auto burglar alarms, pwr supplies from surplus components, "IF" system modules (part 2), vhf FET preamps, educated "idiot" lites, postage-stamp 6M tx, extra class study (part 16), Bishop IFNL, low-band police monitor, mobile cw tx, Wichita auto-patch.

JUNE 70. DDRR ant, vfo circuit, remote SWR indicator, indoor hf vertical, two rx on one antenna, environment & coax loss, 2-el trap verticals, buying surplus, two 40M qrp tx, 21dB 2M beam, extra class study (part 17).

DEC 70. Solid-state vhf exciter, delta-fre control for SSB, 2M transistor FM tx, HW100 offset tuning, "little gate" dipper, 3-500Z hf linear, general class study (part 9), "transi-test" (no good – errors!), transistor p.s. current limiter.

JAN 71. Split fones for dxing, Heath Ten-er mods, cw duty cycle, repeater zero-beater, HEP IC projects, 10-15-20M parabolic ideas, lightning protection, IC rx accessory, attic ants, double-balanced mixers, permanent marker tool, ham license study questions.

FEB 71. Metal locator, veractor theory, AFSK unit, SSTV patch box, ATV hints, RTTY tuning indicator, tone encoder/decoder, 220 MHz converter, SSTV magnetic deflection, IC code osc, 6M tx beeper, general class study (part 6), RTTY intro, perf-board terminal, low-ohmmeter.

MAR 71. IC audio filter, IC 6M converter, trap vertical ideas, digi counter info, surplus equipment identification, hf linear, simple tone patch, repeater audio mixer, digi RTTY accessories, coathanger gndplane, general class study (part 7).

APR 71. Intro to fm, noise limiter, repeater problems, Motorola HT [illegible] crowave repeater linking, dir[illegible]ansfeable 2M fm rx/tx, rep[illegible] fm marketplace, meter av[illegible]ector modulator, simple sig gen, tou[illegible] hookup, hf preselector, 10M 12W tx.

SOLD OUT

MAY 71. 75M mobile whip, 2M preamp, transistor amp design, 10M dsb tx, portable fm transceiver directory, audio compressor-clipper, transistor LM freqmeter, 450 MHz link tx, simple rtl filter, 1-tube 2M transceiver, surplus 2M power amp, general class study (part 8).

JUNE 71. 2M beam experiments, 3 el 2M quad, multi-band dipole patterns, weather balloon vertical, pocket-pager squelch, two-er vfo, tuning mobile whips, transistor pwr supply, capacity decade box, 40M gain ant, general class study (part 9).

JULY 71. IC audio processor, audio sig gen, cw filter, 2M fm osc, 2M collinear vertical, FM supplier directory, Motorola G-strip conversion, transistor beta tester, general class study (part 10).

AUG 71. Ham facsimile (part 1), 500 Watt linear, dimensions for July collinear, 4-tube 80/40 station, vfo digi readout, Jupiter on 15M, general class study (part 11), pink ticket wavemeter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor-agc, multichannel HT-200, ham facsimile (part 2), cause of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heat-sinking, IC pulse gen, tone-patch isolation, hcd wattmeters.

OCT 71. Emergency repeater car, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3-el 75M beam, motor-tuned gndplane, 2M gain vertical, transistor biasing, split-site repeater, fox-hunting, audio filter, transistor diode tester, xtal tester, 6M linear amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp-compressor, Six-er mods, tone patch, Two-er info, solar info, SCR regulator for HVPS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigar-tube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nano-ampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc-diode converter, rtl decade and nixie driver, plus-minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY selcal, IC trf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi-Z voltmeter, Nikola Tesla story, vhf swr meter, transistor regen rx, 432 SSB transverter, AC arc welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M gndplane, IC logic demonstrator, overload protection, if/rf sweep generator, digi freq counter, aural tx tuning.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var. dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT-220 touchtone, 3-el 20M yagi, 50 MHz freq counter, speech processor, 2-tone gen, fm test set, tilt-over tower, 6M converter using modules, tuneable af filter, six band linear, 10M IF tuner, diode noise limiter, cw/ssb agc, HW22a transceiver 40M mod, HAL ID-1 mod.

FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, active filter, time freq measurement (part 2), repeater timing control, SSTV circuits (part 1), 2M converter using modules, multifunction metering, FET biasing, freq counter preamp, TR22 hi power mod, transistor rf power amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info.

APR 73. FM deviation meter, 2M FET preamp, two 2M power amps, repeater control (part 1), repeater licensing, European 2M fm, fm scanner adaptor, RCA CMU15 mods, lightning detector, cb alignment gadget, transistor rf power amps (part 2), repeater economics.

JUNE 73. 220 MHz sig gen, uhf power meter, repeater licensing info, RTTY autoswitch, 40M hybrid vfo tx, ant polar mount, 10-15-20M quad, K2OAW counter mods, double coax ant, ham summer job, tone decoder, field strength meter, nicad battery pack, ohm meter, FCC regs (part 1).

AUG 73. Log-periodics (part 1), tone burst gen, rf power amp design, transistor radio intercom, 160M ant, SSTV monitor, low cost freq counter, VOM design, qrp 40M tx, 432 MHz exciter, fm audio processing, FCC regs (part 3).

SEPT 73. Repeater control system, log-periodics (part 2), 2M rx calibrator, PLL ic applications, TT pad hookup, Heath HW7 "s" meter, Oscar-6 doppler, 2M coaxial ant, 2M converter, IC keyer, measure ant Z, FCC regs (part 4).

OCT 73. GE Pocketmate mods, microwave freq measurement, CA3102E 2M frontend, 2 kw hf linear, rf wattmeter, meter repair, 60/40 dipole, IC "hi" gen, vhf freq multiplier, FCC regs (part 5).

NOV 73. 450 MHz exciter, intro to ATV circuits, nicad voltage monitor, autopatch connections, IC meter amplifier, TR22 ac supply, indoor vertical, IC af filter, momentary power failure protection, 160M ant scoupler, Motorola HT info, SSTV-ISB, Class-B af amp, FCC regs (part 6).

DEC 73. Code speed display, 2M kw amp, IC keyer, 8038 waveform gen, helical resonator design, sensitive rf voltmeter, proximity control switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, cw filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amps, scope sweep gen, 15/20M vertical, telephone line control system, pc board construction, var-Q af filter, blown-fuse indicator, 40m cw stn with Ten-Tec modules, simple preamp-compressor, single-IC rx, "432-er" final assembly, transistor keying circuit, 7-segment readout with nixie driver.

APR 74. Vox for repeaters, tone-operated relay, hf transverter, 10-to-2m tx converter, remote control panel for scanner, RCA fm tx tuning, subaudible tone gen, FCC regs (part 9), Repeater Atlas.

MAY 74. Cd car ignition, audio compressor info, interference suppression for boats, auto burglar alarms, 2m ic preamp, 10m fet con-verter.

JULY 74. 4-1000A linear, universal freq gen, universal afsk gen, 555 IC timer, 80M phased array, 135 kHz-432 MHz preamps, 10M qrp am tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 450 MHz FET preamp, use gdo to find "c", Trimline tt pad hookup, R390 & R392 rx mods, tracking cw filter, aural voltmeter, universal regulated supply, sstv scan converter, ttl logic problems, ID timer.

SEPT 74. MOSKEY electronic keyer (part 1), ex warning system, Heath 10-103 scope mods, qrp 6M am tx, rf speech clipper, audio noise limiter, vox satellite on SSTV monitor, universal IC tester, miniature rig construction, tower construction, infinite rf attenuator, electronic

(More)

photo flash ideas, IC "select o ject."

OCT 74. Microtransistor circuits, synthesized HT 220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi power lo pass filter, 6M preamp, 3 wire dipole, ATV sync gen, NCX 5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT 220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas, TTL logic probe, public service band converter, tuned diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 Index

FEB 75. Heath HO 10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar 7 operation, satellite orbital prediction, Heath SB 102 mods, comparing FM & AM, repeater engineering, Robot 80 A sstv camera mod, neutralizing Heath SB 110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. 950 walky for 2M, 2M scanning synthesizer, 8B mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R 11A surplus rx conversion, 5/16 wave 2M ant, Hallicrafters SX 111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM buyer's guide, wx satellite monitor, cmos "accu keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk in, NE555 preset timer, power failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T 44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

OCT 75. A deluxe TTY keyboard (part 1), Op Amps: a basic primer, an introduction to microprocessors, 2m Synthesizer (conclusion), Satellite Fax System (conclusion), regulated supplies (dispelling the mystery), Digital Logic made simple, FCC interview, a contest uP system, digital clock time bases, the operating desk, QRP 432, ham PR.

NOV-DEC 75. Blockbuster double issue! Flip-flops exposed, breakthrough in fast scan ATV, strobing displays is cool, the tuned lunch box (antenna tuner for HF transceiver), a deluxe TTY keyboard (part 2), the 127° rotating mast, less than $100 multi-purpose scope for your shack (part 1), predicting third order intermod, feedline primer, QRMing the Third Reich, why tubes haven't died, instant circuits – build your own IC test rig, the K2OAW synthesizer PROM-oted, a ham's intro to microprocessing, Ground Fault Interrupter (a keep alive circuit for yourself), a $1 strip chart recorder, an even simpler clock osc., the Fun City surplus scene, updating the Heath IB-1101 counter, 256 pages!

JAN 76. Clocks – Really Simplified, De-Strain your Ham-M, An Automatic Dueler for the Deluxe Mobile, Zapping Dead Nicads to Life, The Computer QSO Machine, $50 Self-Powered Counter, Save Money on Coax, How to Pass Exams, Using a Bargain Surplus Keyboard, Improve Your SSTV with the FRAMER, and more. The first 72 in new large format! (Includes 1975 Index to 72).

FEB 76. Build a StarHeat Communicator – Trekkies Special, Synthesized IC Frequency Standard, You Can Make Photo PC Boards, How's Your Speech Quality?, ASCII to Baudot Convertor, RTTY Autocall – the Digital Way, Improving the FT-101, Night DXing on 10 and 15m, Really Snap Up Your 2m Receiver, Put Your 88-108 on 160m.

MAR 76. Special Surplus Issue – Tunable FM Receiver Strips, Surplus Circuit Boards – A Gold Mine of Parts, Space Age Junque, A PC Board Bonanza, Government Surplus: Is It All Gone?, Stereo – A New Type of CW Filter, Build This Exciting New TVT, The Smart Power Supply, How to Use Surplus Pots.

APR 76. Special FM Issue – A Programmable [illegible], Put That AM Rig on FM, A COR for your Receiver, [illegible] Receiver, Long Distance C[illegible] TT Decoder, One IC Tone Buster, Th[illegible] Doubler, A Versatile TTY Generator, The P.L.L. – Explo[illegible] in-22 Tips, Computers Are Ridiculously Simple.

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JUN 76. VHF Special – Super CDR – Digital of Course!, Touchtone Decoder – Using a Calculator Readout, Simple Amateur TV Transmitter, Amateur TV Receiving System, Module Autodialer, Autocall '76 – Using a Touchtone Decoder, Build This Lab Type Bridge – and Measure Transformer Impedances, How Those Triangle Things Work – a Sort of Op Amp Handbook, Those Exciting Memory Chips – RAMs, ROMs, PROMs, etc., ASCII/Baudot with a PROM – for Ribbonless RTTY on Computers, Aim Your Beam Right – With a Programmable Calculator.

JUL 76. Perfect CW – Grow 'em Crazy with the Keyzader I, The Mini-Mite Altband QRP Rig – A Mighty 7 Watts, A Fun Counter Project – Under $60, Build a FAX from Scratch – Then Get Satellite Pictures and Other Things, Der Repeatermeister – Repeater Control with IO, The Giant Nixie Clock, Creative SSTV Programming, CW Regenerator/Processor, What's Up on 156 MHz?, TT Pad for the Wilson HT, Power Supply Testing – To Save Your Digital Circuits, A RTTY/Computer Display Unit, Your Computer Can Talk Morse, Gain for Your HT – a Half Wave Whip, The Super Transmatch, Simple VHF Monitor.

AUG 76. How Do You Use IOs? – Fundamentals, Surprising Miniature Low Band Antenna – the DDRR (Part I), MINI-MOS – the Best Keyer Yet?, The Skeptic's Delight Broadband – Cheap Simulcast of a Commercial IC DIP Board, More PLL Magic, The Logic Grabber – Selected Interval Logic Trace, Global Calculations for the DXer – Using a Hand Calculator, Instant Counter Calibration – Using Your TV Set, Simple 450 MHz Rig – Go ATV With a $42.50 Module, The First Computer Controlled Ham Station – Grand Prize Winner, The Winch Chip Dissected – 4, 8, 12, or 16 bits: pros and cons, Meaningful Conversations with your Computer – What All Those Mysterious Languages Are All About, A Baudot Monitor/Editor System, A Logic Probe You Can Hear, Satellite Orbit Predicting – Using a Pocket Calculator, FSK with the SB-401, Build the Seller RTTY Terminal, El Chespo Signal Tracer – Test Gear for the Cheapskate.

SEP 76. The Surprising DDRR Low Noise Antenna (part III), Ultrasimple Regulation with New IC – Power Supply Design Greatly Simplified, Can an Indoor Antenna Work – Making the Best Out of a Bad Bargain, Inexpensive 12 Volts for Your Ham Station, A Test Lab Bonanza – Using a Transistor Radio, Protect Your VHF Converter – Novel Antenna Relay, Ridiculously Simple RTTY System, How to Catch a Caller, A 450 MHz Transceiver for Under $130, Space Age Junque II, PROM Memory Revisited, Eight Tape Scope Adaptor, The PROM Zapper, Sneaky Speaker – With an ASCII Keyboard, Simple Graphics Terminal – Using surplus, Counters are Not Magic – They're Simple.

OCT 76. Build a Wind 2 Band Mobile Antenna, Build a Counter for Your Receiver, How do You Use IOs? (part III), QRP Fun on 40 and 80 – Have a Real Ball with Just 5 Watts, The Hybrid Quad – Low Windload, Expense, Hassle!, Frequency Detector for Your Counter, Programmable CW ID Unit – for RTTY, Repeaters, Mobile, etc., New IOs for the Counter Cultists – Simpler Counters with Less Used Power, Is My Rig Working or Not? – Build an Effective Radiated Field Meter and Keowl, Quickie Coilwork for 15 and 10 – a Satisfaction Guaranteed, Build a Super Standard – Goes Right Down to 1 Hz, The Incredible Lambda Diode, Mechanical RTTY Buffer, Have You Used a Triac Yet?, How to Interface a Clock Chip – Baudot, BCD, or ASCII Conversion, A TTL Tester – Great for Unmarked Bargain ICs, The New Ham Programmer – Making Those Confounded uPs Work, BASIC? What's That? – the Beam of BASIC, The Soft Art of Programming (part I).

NOV 76. Blockbuster 288 pg issue! Cordless Iron Tips, Bicycle Mobile, Build a Simple Lab Scope – Costs Less Than $70!, Get on Six with Surplus – The El Chespo RT-70 is a Natural, The Beam Saver – Rotor Memory System, Updated Universal Frequency Generator, The Short Pocket Touchtone, Liquid Crystal Display Guide, Self-Powered Mike Preamp, The Wind Counter, The 538 is Not Dead!, The Amazing Inverted L – Antenna for 20, 40, and 80m, Battery Chargers Exposed, How Do You Use IOs (part III), Thirty Years of Ham RTTY, Big Noise Burglar Alarm, Dandy Digital Dial Decoder, Weather Satellite Display Control, Ham Time-Sharing a Home for Two!, The Soft Art of Programming (part III), OSCAR Orbits on Your Altair, ASCII/Baudot Converter for Your TVT, The Simple Timer – Power Supply Timer, The Man Who Invented AC – Tesla, the Greatest Pioneer of Them All!, Baudot to ASCII – You Want to Learn Programming?, Baudot and BASIC – an Interpreter for a Baudot Computer, Toward a More Perfect Touchtone Decoder, Using a Wireless Broadcaster, The Quiet Spy – Amateur Uncovers Spy Ring in the USR, The Benefits of Satellite Monitoring – And How to Do It.

DEC 76. Go Tone for Ten – Simple Subaudible Encoder, World's Simplest Five Band Receiver?, How Do You Use IOs? (part IV), A Super Cheapo CW ID'er, The ZP Special Antenna, CT 7001 Clockbuster, Saving a Caller, A Ham's Computer, What's All This LSI Junk? – an Ostrich's Eye View of the Microprocessor, The Soft Art of Programming (part III), Put Snap into Your SSTV Pictures – Using a 526 Frequency Standard, What's all This Wire-Wrap Stuff? – Talk About Cold Solder Joints!, Exploding the Power Myth, Exploding the SWR Myth, The IC-22 Walkie – Pursublimation with Nicads, Watch DX with a Spectrum Analyzer, DXing with a Weather Map.

HOLIDAY 76. 50 article issue! An Inexpensive 400 Watt HF amplifier, How Do You Use IOs? (part V), Mobile Doppler Detector – 10.5 GHz: Use It or Lose It!, Add RIT to Your Transceiver, DXpedition: Memories for a Lifetime – Reflections of HK1TL, Design Your Own QRP Dummy Load, Failsafe Super Charger – Multi-use too!, The Amazing 18" Antenna for 160m, Replacing the Knife Switch – Simple TR System for the Novice, How You Can Synthesize – the VHF Engineering Approach to 2m Happiness, Hutchinson's Remedy – The Chapman CW Machine, The Mod Squad Does the Pocket Scanner – Radio Shack Pro-4 Update, TR-22 Mod Squad, What Computers Can and Can't Do, A Ham Shack File Handler – Program in BASIC for OSCs, Repeaters, etc., Print Your Own Logbook – On Your Nearest Computer, Shaking Your HT, Cash In on the CB – Installation for Fun and Profit, Taming Those Big Antenna Coils, The 2m Mod Squad Tackles the Weather Radio – and Wow!, Hamming by Laser, A 88 Foot Antenna on a 28 Foot Lot – Solving a 40m Novice problem, Dual Voltage Power Supply, An Aeropostal Busy Signal, Inside the GLB – a Gusty Look at a Synthesizer, How to Bug an Accidental Keyer, A 450 Duplexer – That Fits on Your Car, Will Silver-Zinc Replace the Nicad?

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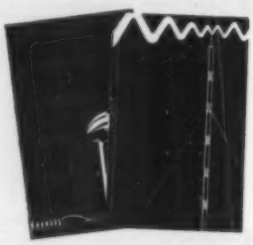

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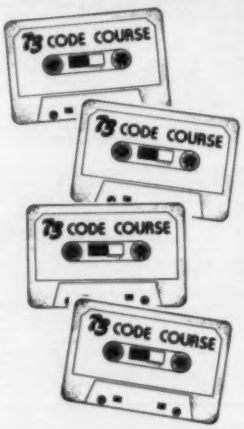

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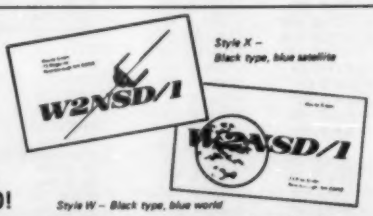

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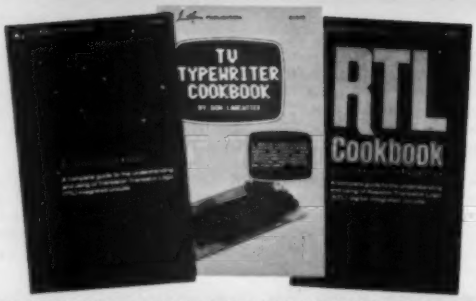

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